

EVOTED EXCLUSIVELY TO METALLIC SURFACE TREATMENTS

# METAL FINISHING

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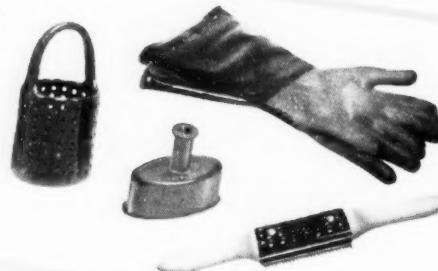
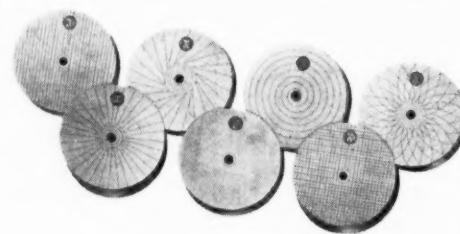
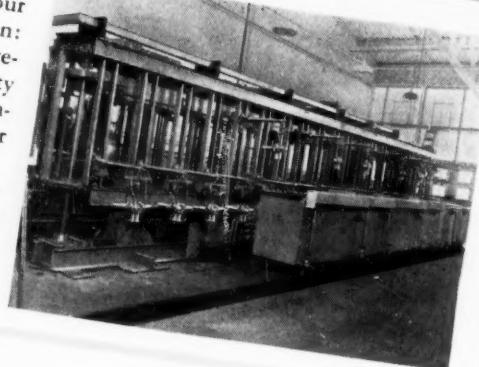
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ESTABLISHED 1903

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# METAL FINISHING

## Metal Cleaning—The Great Unknown

Nothwithstanding the ascending application of scientific principles and close analytical control which now prevails in the electroplating industry, it is surprising, as well as disconcerting, to realize that there still does not exist an accurate, practical method for determining when and if a metallic surface is sufficiently clean to permit the maximum of adhesion and receptance of a subsequent electrodeposit. This, in spite of the fact that by far the largest majority of plating headaches are usually attributed to improper surface preparation in the cleaning stages.

From a more practical standpoint, what would probably be more useful would be a means for determining when a given cleaner had lost its effectiveness, when used in a standardized, routine manner. Discarding the cleaner bath at arbitrary or prescribed intervals can be quite wasteful and costly in many cases, while the alternate procedure of waiting until trouble develops in the plating operation before changing the cleaner can be even more costly, delaying, and annoying. The familiar "water break" test is very useful as far as it goes, but it fails to indicate the presence of adsorbed films, oxides, etc., that may interfere with deposition or adhesion or cause contamination in later operations. Tests on the cleaning bath itself, such as alkalinity, pH, conductivity, rinsability, etc., are also useful and informative, but at best are only an indirect means of achieving the desired control. What is needed is a quick visual check that would give the plater the "green light" for following operations.

Development of such a test is, admittedly, not an easy task because of the wide variety of base metals, soils, films, and other factors encountered. However, the great amount of research being focused at the present time on the fundamental mechanism of cleaning and plating should be equal to the task. The increased efficiency and economy resulting from the development of such a test would provide a major step in the progress of the plating industry.

*H. A. Raymond*



# Diversified, Modern Job-Shop Plating

By Fred M. Burt, *Los Angeles, Calif.*

The diversity of products handled in the average plating job shop would soon make a shambles of the standardized routine of most production shops. How this wide variety of products are handled in an efficient and cost-competing manner in a modernly equipped job shop is outlined in this article.—ED.

THE modernly equipped plant of the *Cadmium & Nickel Plating Company*, of Los Angeles, with 21,600 square feet under roof, is one of the largest custom plating plants in the Western States, with a high degree of mechanization and great diversity in its plating operations.

Started in 1931, in a small shed with one plater, co-owners *M. W. Hays* and *Oliver S. Pendlay* have since developed the business to a point where added space requirements called for two moves before the war. In their final location since 1941, wartime production demanded seven day operation around the clock, and covered the plating of millions of parts, small to large in size, in diverse finishes. While this was going on, however, plans were aimed at being ready for the post war competition in the plating field, calling for two additions in 1943, to house barrel plating equipment and the maintenance department.

One major innovation has been the development of a mechanical chrome plating process. This is one of the relatively few companies in the United States with equipment and plating procedures enabling them to do this chrome plating in quantity batches, mechanically handled through the successive steps of cleaning and plating. In the old, and more common method of doing this chrome plating, each part, screws for in-

stance, had to be racked up individually, making it virtually a hand plating job. This made an almost prohibitive plating cost. With the new mechanical method, instead of a screw plating job costing a couple of cents or so, top quality chrome plating can be done for but very few dollars per thousand screws, depending on size. This reflects a cost saving up to 90%. This is but one of the plant's operations, however.

The greatest weight of plating is in the cadmium barrel plating department, principally on such small parts as nuts, bolts, screws, electrical parts, screw machine parts, radio parts, etc. Larger units are cadmium plated for corrosion protection on the automatic machines, to be described further on. Production is rated



Co-owners *M. W. Hays*, left, and *Oliver S. Pendlay*, right, with General Manager, *E. T. Brown*.

in pounds rather than in numbers of parts, as it is the only practical method, when it is considered that production runs up to as much as two tons of parts plated per hour, or some place between 100,000 and 200,000 pieces per hour.

Parts are delivered by one of the company's three large stake body trucks, or by customer delivery. The truck backs into a truck well, where the kegs or boxes of parts are unloaded in a large, clear storage area used for both receiving and shipping.

As scheduled for production, a cleaning-barrel load of parts is dumped into a hopper at the end of the cleaning line (Figure 1). These perforated Monel metal barrels, 42" long and 14" diameter, have a 500-lb. working capacity. One of the three 1/2-ton electric hoists on the monorail that runs over the centers

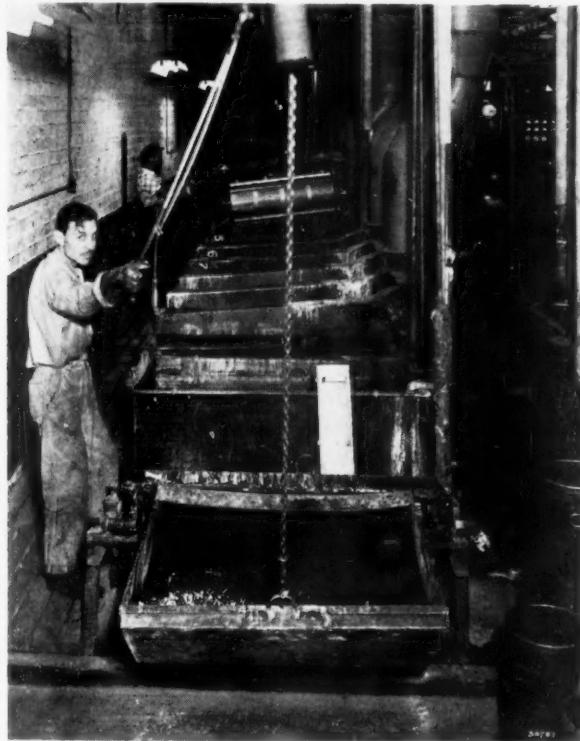


Figure I. Cadmium barrel cleaning line. Hopper in foreground is lifted by electric hoist to dump contents into cleaning barrel behind it. In background, perforated Monel metal basket is being moved from rinse to pickle tank.

of the tanks, lifts the hopper to dump its contents into an empty barrel. From here on the sequence of operations is as follows:

TANK	BBL. CAPY.	TIME MIN.	TEMP. F.	SOLUTION
1. Pre-cleaning	1	1	200°	alkaline cleaner
2. Cleaner	4	5	200°	Same
3. Rinse, double	2	1	cold	Water
4. Pickle	2 to 5		140°	20% H <sub>2</sub> SO <sub>4</sub>
5. Rinse	1 quick		cold	Water
6. "Sour water"	2		cold	Weak HCl

The revolution of barrels at about 30 r.p.m. is actuated at each individual location by motor driven gearing which engages the gear on the end of the barrel. Ducts mounted over the tanks between barrel place-

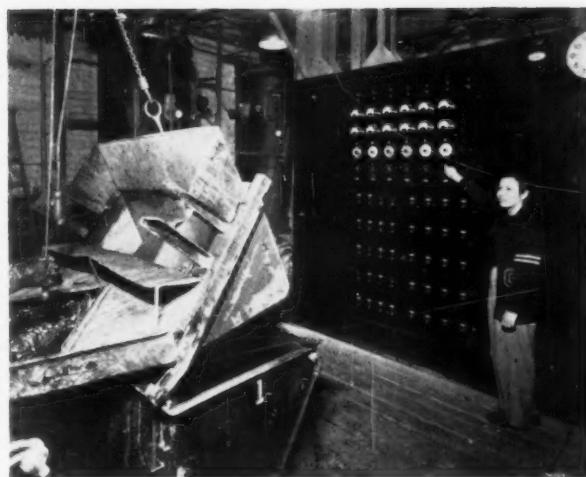


Figure II. At left, 500 lb. capacity cleaning barrels split their contents into two halves of transfer hopper. The hoist lift dumps contents of one side into a 250 lb. capacity plating barrel, then after moving gate, other half into another barrel. Half of the switchboard is shown in rear. Above in vertical rows are Red and Green signal lights, ampere and volt meters, time clock, switch, and tab showing plating barrel number controlled by the row. When a plating barrel is lowered into a plating tank, the girl throws its switch, the plating current is on, the barrel starts revolving and a green light shows. When the pre-set plating time elapses, a red light replaces the green, current goes off, barrel stops. Time clock settings are varied to suit the jobs. Below are master switches for barrel rotation motors and for plating current. Behind the girl is door to master switches for rectifiers in rear.

ment locations pull the fumes away with a strong, blower-actuated, up-draft through pipes running out through the roof. The tanks are heated by steam coils, with low-pressure steam generated in three tubeless boilers located in the corner at the end of this line. These boilers also supply tank heating requirements throughout the plant.

The cleaning line is operated by two men, the first one transferring the barrels on to the second man. After the latter removes the barrels from the last tank, they move through a right angle turn on the monorail, to the transfer unit at the end of the first of the two parallel cadmium plating lines, and the parts are dumped into the transfer unit. The transfer unit serves



Figure III. Two cadmium plating lines. Switchboard in center background. Cleaning line at left.

both plating lines, which are alike and each has three 1/2-ton electric hoists on its monorail. (See Figure II.) Here the first operator on the plating line dumps the load into the transfer hopper and thence into two perforated melamine, 42" long, 250-lb. capacity plating barrels. Coming forward in each plating line, there are, 1) two cadmium plating tanks (each of three barrel capacity), 2) three cold water rinses, 3) a hot water rinse at about 180°, and 4) a transfer tank where the cylindrical barrels have their loads dumped into perforated, round steel baskets, 26" diameter, and 11" deep. These are placed successively in a centrifugal dryer in which they are rotated at high speed while hot air is blown in on them from a heat-exchanger unit mounted overhead (Figure III). After this the contents of each basket pass through a funnel-transfer unit, and into the company's standard steel containers. These are steel cans 18" deep, 12" diameter, or tote boxes 10½" x 20½" x 8" deep. All through the plant

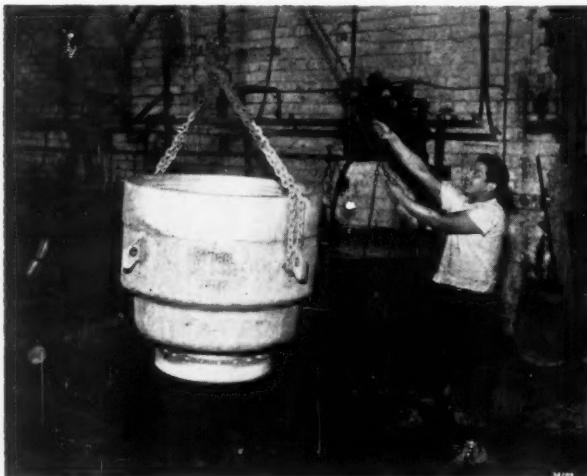


Figure IV. Just removed from 6' x 6' cadmium plating tank, is 4718 lb. main body of oil well blow-out preventer.

are numerous two-wheel hand trucks with special lifting plates of different sizes and designs to suit a variety of handling requirements. Several lift trucks are used to move palletized loads.

Paralleling the second plating line is a row of seven cylindrical burnishing barrels for small parts. Burnishing requires from 10 minutes to two hours, depending on the plating and base metal. After leaving a burnishing barrel, parts move through a hot water bath, a centrifugal dryer, a sawdust tumbler and a sawdust shaker.

A six foot deep, six foot diameter plating tank is used for special, large plating jobs. One of the largest of these special jobs was the cadmium plating to a .0005" thickness of a large steel casting weighing 4718 lbs., used as the main body of an oil-well blow-out preventer (See Figure IV). The full operation was: 1) grease removal on the floor with solvent cleaner, 2) brushed down, 3) further cleaning with hot alkaline cleaner, 4) cold water rinse, 5) swabbing with "sour

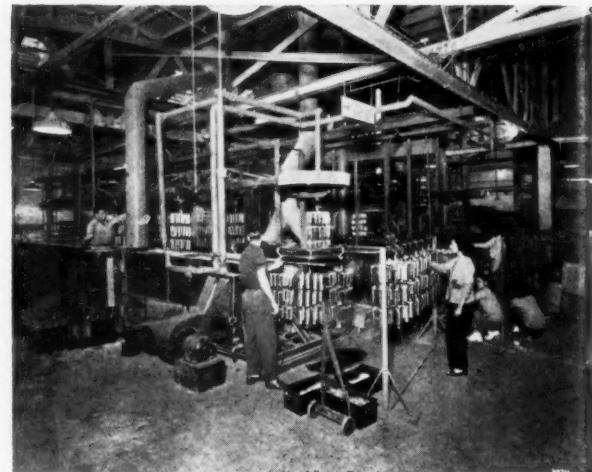


Figure V. Two automatic plating machines for cadmium. One in foreground is plating flashlight sections, other one conduit boxes. Man at left removes racks for bright dip, then replaces for continuance of cycle.

water," 6) another rinse hosing, and 7) into the plating tank for about 40 minutes.

Two large return-type, full-automatic plating machines are used for continuous cleaning and cadmium plating of racked parts (Figure V). After the parts are racked, the racks are hung on the conveyor hooks at the loading position from which they travel through a sequence of baths similar to those in the barrel cadmium plating; cleaner, rinse, pickle, rinse and into the 1600-gal. cadmium plating tank. Coming back, the racks are removed from the conveyor by an operator who immerses them in a bright dip tank at the side, then hanging them back on the conveyor to continue the cycle through a cold water rinse, a hot water rinse, the drying oven, and on for unloading, close to where they started.

The controls provide for a variable plating time of from 12 to 32 minutes, with a clock-setting controlling the pause period or immersion time. Racks for this and other plating jobs, are made of phosphor bronze. Copper wire of 18, 20, 22, and 24 gage are used to

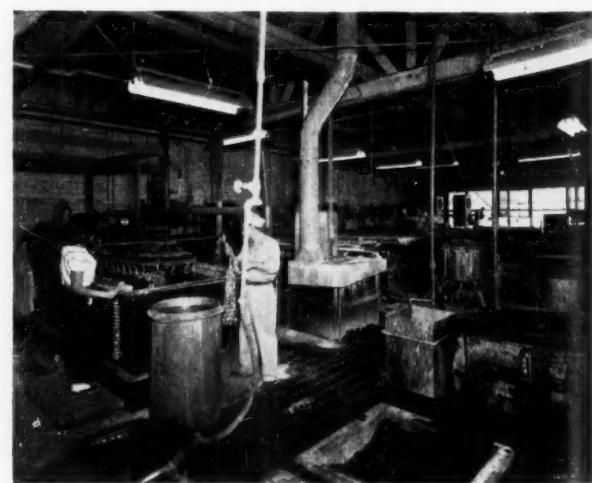


Figure VI. Semi-automatic nickel plating tank at left—then rows of tanks for variety of special plating jobs. In center is a filter used with high-speed copper plating tank.

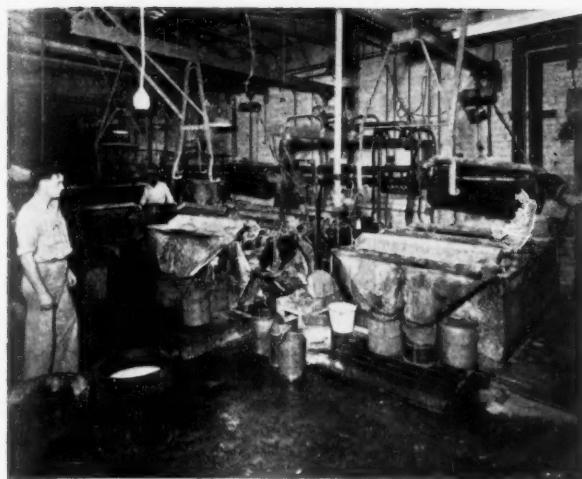


Figure VII. Miscellaneous barrel plating department, with cleaning tanks off to left.

mount the thousands of other miscellaneous units to be plated. This work is done by groups of girls at well equipped tables located conveniently close to the plating tanks.

Another group of tanks is used for a wide diversity of work. Many of these are shown in Figure VI. Starting with the semi-automatic, 1500 gallon, nickel plating tank at the left, the other 500 to 600 gallon tanks are bright nickel, high-speed copper, Rochelle copper, bright nickel (two tanks), Watts nickel, brass, silver, and tin. Opposite them, on the right, are the cleaning tanks.

In the miscellaneous barrel department, (Figure VII) smaller runs of special plating jobs are made. Many of the barrels used have vertical center partitions so that half loads of different items can be plated at the same time. Plating is done with nickel, brass, bronze, copper, tin and cadmium.

Controls of plating and allied operations are many, varied, and constant. In a well equipped laboratory, (Figure VIII) staffed with a control chemist and his



Figure VIII. Control laboratory—main items of equipment include rectifier, Hull cell for solution testing and pH meter.

assistant, all solutions are checked and recorded periodically. As a further insurance, regular checks and advices are provided by an outside consultant. An example of checks made and records kept is the following from the Log Book—on No. 2 automatic cadmium plating tank—the entries made three times a week are under the following heads:

1—Date, 2—Total % Cyanide, 3—% Metal, 4—% Free Cyanide, 5—% Caustic Soda, 6—Ratio, and 7—Remarks (such entries as "When Filtered," "additions made," etc.)

Spot checks are also made regularly on all plating operations, using the drop test for checking deposit thickness.

The Maintenance Department is housed in a 40' x 60' building in the rear (Figure IX). It is rather remarkable that, in the great variety of supply items and repair aids that are contained therein, almost to



Figure IX. View of work bench section of Maintenance Dept. At left mechanic is putting new gear on plating barrel; at vise, a plating rack is being assembled; at right, small Monel metal basket being repaired with oxy-acetylene torch.

the point of crowding, yet by virtue of having a specific place for everything and then putting and keeping it there when not in use, and through a high standard of good housekeeping, the department always looks quite orderly. This department's personnel is responsible for much very ingenious work in engineering, designing, constructing, and/or installing much of the special equipment in the plant.

Besides the large battery of copper sulfide-type rectifiers behind the barrel department switchboard, several more of these rectifiers are located in convenient locations close to other plating units. Other current supply comes from two 3,000 ampere DC generators.

Besides the departments illustrated, there is a still tank department, equipped with four tanks, 8' to 14' long, for cadmium plating of parts not suitable for barrel or automatic plating.

Combined, all of these departments with the units of equipment therein, and the efficient working procedures developed and adhered to, make up the pattern of a very versatile, custom plating plant.

# The Analysis of Chrome Plating Solutions

By Louis Silverman, Los Angeles, Calif.

This article details a method for the determination of both chromic acid and trivalent chrome that is much more rapid than the methods in common use in most plating laboratories. The author also includes an interesting new theory regarding the role played by the sulfuric acid catalyst in chrome plating.—ED.

**I**N THE analysis of chrome plating solutions it is often necessary to test for certain impurities, either as a check on drag-in in automatic plating machines or as a check on the operating condition of the bath. Methods for accurately determining some of the more common impurities often found in chrome solutions are given in the following paragraphs, together with several newer methods for the usual constituents. It is believed that the methods given are more rapid and accurate than those commonly used in routine analysis.

In addition to tests on the plating baths themselves, it is often necessary to check the composition of the lead alloy anodes used, and methods for analysis of tin-lead, antimony-lead, and tellurium-lead anode alloys are presented.

## Determination of Chromic Acid and Tervalent Chromium

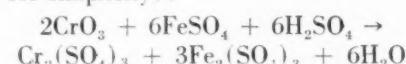
### THE PERMANGANATE-FERROUS SULFATE TITRATION METHOD

Ferrous sulfate reduces hexavalent chromium to trivalent chromium in acid solutions. A moderate excess of ferrous sulfate is added to the chromic acid solution to reduce the chromium, then the excess of ferrous iron is back-titrated with standard permanganate solution. The end point color change is from green to lavender. To determine trivalent chromium, a separate test solution is boiled with perchloric acid to oxidize the trivalent chromium to the hexavalent stage. The total chromium value is now determined as above, and the difference between the two values is due to trivalent chromium.

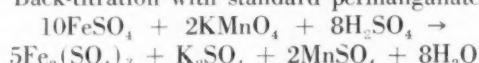
Hexavalent chromium may be determined separately ("h"), but in order to determine the amount of trivalent chromium two determinations ("h") and ("t") must be run.

#### EQUATIONS:

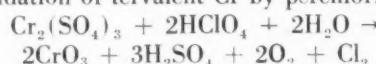
1. Reduction by ferrous sulfate ( $\text{CrO}_3$  is used for  $\text{H}_2\text{CrO}_4$  for simplicity):



2. Back-titration with standard permanganate:



3. Oxidation of trivalent Cr by perchloric acid:



#### PROCEDURE:

Pipette a 10 ml. sample of plating solution into a 500 ml. volumetric flask. Dilute to the mark with water and mix thoroughly. Pipette two 25-ml. aliquots from the volumetric flask and transfer each to 600-ml. beakers, (h) and (t) for the chromic acid and trivalent chromium determinations, respectively.

**Chromic Acid:** Add to beaker (h) 25 ml. of (1:1) sulfuric acid, 5 ml. of phosphoric acid and 300 ml. of water. Stir. From a burette add 70 ml. of 0.1 N ferrous sulfate solution. Stir, and the solution turns green. Back titrate with standard 0.1 N potassium permanganate solution to the first color change (green to lavender). This is titration (h).

One other titration, the permanganate equivalent (p) of the ferrous sulfate solution, is required. Add 70 ml. of the ferrous sulfate solution to another 600-ml. beaker, and mix with 25 ml. of (1:1) sulfuric acid, 5 ml. of phosphoric acid and 300 ml. of water. As before, titrate with the same permanganate solution. The number of ml. of permanganate used is the permanganate equivalent (p). These two titrations, the (p) and the (h) are needed for the calculation.

#### Calculation:

$\text{CrO}_3$ , oz. per gal. =  $(p-h) \times \text{Normality of KMnO}_4 \times 8.9$  or (ml.  $\text{KMnO}_4$  equivalent—ml.  $\text{KMnO}_4$  back titration)  $\times \text{Normality of KMnO}_4 \times 8.9$ .

The following elements do not interfere: alumi-



#### The Author

Mr. Silverman is well known among analytical chemists through his extensive writing, having contributed over 40 articles on various phases of metallurgical and electroplating analytical work. He is a graduate of Carnegie Tech, and has been employed by the U. S. Navy, Home Soap Co., Westinghouse, and is presently with Eastern Smelting and Refining Co., in Los Angeles.

num, barium, cadmium, copper, iron, lead, manganese, nickel, silver, zinc.

**Tervalent Chromium:** Add to beaker (t) 15 ml. of perchloric acid. Cover and heat until perchloric acid condenses on the underside of the cover glass. Heat one minute more. With tongs, remove the beaker from the heat, hold the beaker in air for half a minute, then cool in running water. Add 50 ml. of water, mix and boil for one minute to get rid of chlorine fumes (see equation 3 above). Cool in running water and add 25 ml. of (1:1) sulfuric acid, 5 ml. of phosphoric acid and 300 ml. of water. From a burette, add 70 ml. of a 0.1-N ferrous sulfate solution. Stir. Back-titrate with standard 0.1-N potassium permanganate solution to the first color change (green to lavender). This is titration (t).

#### Calculation:

$\text{Cr}^{+++}$ , oz. per gal. =  $(h-t) \times \text{Normality of KMnO}_4 \times 4.63$  or,  $(\text{ml. KMnO}_4 \text{ of chromic acid back-titration} - \text{ml. KMnO}_4 \text{ of tervalent chrome back-titration}) \times \text{Normality of KMnO}_4 \times 4.63$ .

Note that ferrous sulfate figures are not used and that the permanganate equivalent titration (p) is not needed, as algebraically, it can be shown that:

Tervalent Cr, oz. per gal.

$$\begin{aligned} &= [(p-t) - (p-h)] \times N \text{ of } \text{KMnO}_4 \times 4.63 \\ &= (p-t-p+h) \times N \text{ of } \text{KMnO}_4 \times 4.63 \\ &= (h-t) \times N \text{ of } \text{KMnO}_4 \times 4.63, \end{aligned}$$

where (p-t) is the titration of chromic acid plus the oxidized tervalent chromium, and (p-h) is the titration of chromic acid in the plating bath.

#### POTENTIOMETRIC METHOD

The titration of chromic acid with ferrous sulfate is simply and rapidly performed potentiometrically. All the popular models of potentiometers are suitable, and many pH meters are fitted with accessories so that the pH meter may operate as a potentiometer. Some instruments have a "blinking eye" and others have a "moving needle" or similar arrangement.

Prepare the solutions as usual, except that phosphoric acid is not required. Solutions usually contain 5 to 10 per cent by volume of sulfuric acid, and the titration is performed with cool solutions.

Set the beaker and solutions in place with the electrodes. Before adjusting the instrument, add about 30 ml. of ferrous ammonium sulfate solution from the burette, then adjust the "needle" or "eye" position. Continue the titration with ferrous sulfate until just one drop of reagent permanently moves the "needle" or "blinks the eye." This is the end point, although some analysts prefer to add an excess of ferrous sulfate, and back-titrate as in the visual method. The permanganate equivalent of the ferrous sulfate is obtained in the same manner.

For the first method (no back titration), the calculation is as follows:

$\text{CrO}_3$  oz. per gal. =

[exact ml. of  $\text{KMnO}_4$  equivalent of  $\text{FeSO}_4$  used]  $\times \text{Normality KMnO}_4 \times 3.9$

$\text{Cr}^{+++}$ , oz. per gal. =

[exact ml. of  $\text{KMnO}_4$  equivalent of  $\text{FeSO}_4$  used]

for  $\text{Cr}^{+++}$ —exact ml. of  $\text{KMnO}_4$  equivalent of  $\text{FeSO}_4$  used for  $\text{CrO}_3$ ]  $\times \text{Normality of KMnO}_4 \times 4.63$

The calculation for the second method, using a back-titration, is the same as if no potentiometer were used.

#### Determination of Sulfuric Acid

##### GRAVIMETRIC METHOD—

##### HYDROXYLAMINE HYDROCHLORIDE REDUCTION

Barium chloride reacts with sulfuric acid to precipitate barium sulfate. Barium chromate would also precipitate, and to prevent this, hexavalent chromium is first reduced to tervalent chromium, which does not precipitate with barium chloride.

The complex ion  $[\text{Cr}_2(\text{H}_2\text{O})_2(\text{SO}_4)_2]^{++}$  which contains sulfate ion in a manner that will not react with barium chloride is first decomposed by acetic acid. The liberated sulfate ion easily forms barium sulfate.

#### EQUATIONS:

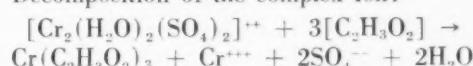
1. The barium sulfate precipitation:



2. Reduction by hydroxylamine hydrochloride:



3. Decomposition of the complex ion:



#### PROCEDURE:

Pipette a 10 ml. sample into a 400 ml. beaker and add 200 ml. of water. (If any insoluble material is noted, filter the solution through qualitative paper into another 400-ml. beaker, and wash well.) Add 25 ml. of acetic acid and 2 ml. of hydrochloric acid. Dissolve 6 grams of hydroxylamine hydrochloride in 10 ml. of hot water, then cool. Slowly add the cool hydroxylamine hydrochloride solution to the chromic acid solution, while stirring. The chromic acid (red) is reduced to tervalent chromium (green). (Caution—considerable heat evolved.) Heat the solution to boiling, and add, dropwise, 15 ml. of a 10 per cent barium chloride solution, stirring continually. Maintain the solution at the boiling point for 15 (or more) minutes, stirring occasionally, then remove from the heat, stir in a little paper pulp and let the precipitate of barium sulfate settle for 5 minutes. Filter the solution through a 12.5 cm. No. 42 Whatman paper, drain, wash and police the beaker with a hot wash solution (one gram of barium chloride and 10 ml. of hydrochloric acid per liter.) Wash the paper 6 times with this solution to remove the chromium and iron, then 6 times with hot water to wash out the barium chloride. Transfer the paper and contents to a clean crucible. Dry the paper on the hot plate, then heat to char the paper completely. Finally, ignite the crucible at 900°C. in a furnace. Cool the crucible to room temperature. Tap or brush the barium sulfate onto the balance pan and weigh.

#### Calculation:

$\text{H}_2\text{SO}_4$ , oz. per gal. = Weight of  $\text{BaSO}_4$ , gm.  $\times 5.64$

It is advisable to run blanks on the reagents.

## CENTRIFUGE METHOD

Pipette a 10 ml. sample into a 400-ml. beaker and add 25 ml. of water. (If any insoluble material is noted, filter the solution through a small paper into another 400-ml. beaker, and wash with as small a volume of water as possible.) Pour in 25 ml. of acetic acid and 2 ml. of hydrochloric acid. Dissolve 6 grams of hydroxylamine hydrochloride in 10 ml. of hot water, then cool thoroughly. Place the 400-ml. beaker in a cold water bath and cautiously pour the hydroxylamine hydrochloride solution into the cold 400-ml. beaker, shaking occasionally. The chemical reaction produces considerable heat. After action slows, remove the beaker from the bath, dry the walls and bottom of the beaker and pour the green solution into a (Goetz) 100-ml. centrifuge tube. Wash the beaker with water and dilute the solution in the centrifuge tube to about 80 ml. Place the centrifuge tube in a boiling water bath and allow 10 minutes for the chromium solution to reach temperature. Add, drop-wise, and with careful stirring, 15 ml. of a 10 per cent barium chloride solution. (The stirring rod should be drawn out at the tip so as to enter the narrow graduated end of the centrifuge tube.) Allow the solution to heat for 15 or more minutes, stirring occasionally. Remove the tube from the bath, support the tube on a ring and allow to cool. Remove and wash the stirring rod. Balance the centrifuge tube against another, using distilled water in the lighter tube. Centrifuge at 1500 to 2000 r.p.m. for 10 minutes. Stop the centrifuge, turn the tubes through 180° and again centrifuge for 10 minutes. Stop the centrifuge, turn the tubes to the original positions, and centrifuge for one more minute. Stop the centrifuge and read the volume of precipitate to the nearest 0.005 ml. The results for sulfuric acid ( $H_2SO_4$ , oz. per gal.) may be obtained from a graph, prepared as follows:

### Synthetic Solutions for Calibrating Centrifuge Tubes

(a) Sulfuric acid. Pipette 4.2 ml. of sulfuric acid (1.335 sp. g.) into a one-liter volumetric flask, dilute to the mark with water, and mix. Prepare a series of nine 400-ml. beakers, and add to each 0, 2, 3, 4, 5, 6, 7, 8 and 9 ml., resp., of the sulfuric acid solution. Determine  $H_2SO_4$ , oz. per gal. as described in the (a) gravimetric method, above. The results should be in exact order. Subtract any blank.

(b) Chromic acid solution, 375 g. per liter, or 50 oz. per gal. Transfer 375 g. of chromic acid to a one-liter volumetric flask, dilute to the mark with water, and mix well. Again prepare nine 400 ml. beakers, add the amounts of sulfuric acid as above and add also 10 ml. of the chromic acid solution, and proceed as in the gravimetric method. Compare the two sets of results, with blanks, and adjust for chromic acid blank. Again prepare beakers but use only the 0, 2, 3, 4, 5, 6, 7 and 8 ml. aliquots and proceed as in the centrifuge method. Plot a graph using "ml. of precipitate" as abscissa and "oz. per gal." as ordinate. The lower part of the graph should be a straight line, but the upper section may curve slightly.

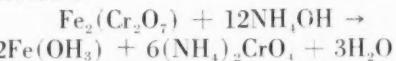
## Determination of Iron

### TITRATION METHOD

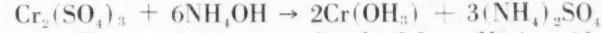
Iron is separated from chromic acid by precipitation as ferric hydroxide. The precipitate is dissolved in dilute sulfuric acid, the ferric iron reduced to the ferrous state by copper powder, and titrated with permanganate. Tervalent chromium does not interfere.

### EQUATIONS:

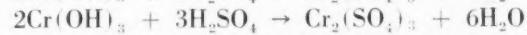
1. Ferric hydroxide is precipitated by ammonium hydroxide:



2. Tervalent chromium may also precipitate:



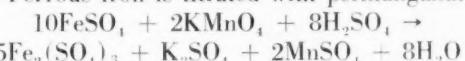
3. The precipitates are dissolved by sulfuric acid:



4. Ferric iron is reduced by copper powder:



5. Ferrous iron is titrated with permanganate:



### PROCEDURE:

Pipette a 10 ml. sample into a 400 ml. beaker and dilute to 200 ml. with water. Add ammonium hydroxide until a permanent precipitate is formed, and the solution turns red litmus to blue. Heat the solution just to boiling, remove from the heat and allow the precipitate to settle. Decant through a 12.5 cm. No. 41 Whatman paper containing paper pulp, then transfer the precipitate to the paper and wash the beaker and paper 6 times with hot water. Discard the filtrate. Return the paper and contents (iron and chromium) to the original beaker and add 100 ml. of cold water and 10 ml. of (1:1) sulfuric acid. Stir to dissolve the precipitate. Add approximately 0.75 g. of copper powder reagent, and stir for 3 to 4 minutes to reduce the ferric iron. Filter through a 12.5 cm. No. 40 Whatman paper, containing a small amount of paper pulp, into a 300-ml. beaker. Wash the beaker and paper 5 times with cold water, taking the precaution that the copper powder does not creep over the paper. Discard the paper.

To the filtrate add 10 ml. of (1:1) sulfuric acid and 5 ml. of phosphoric acid. Titrate with standard 0.1 N potassium permanganate solution to a pink color.

### Calculation:

$$\text{Fe, oz. per gal.} = \text{ml. } KMnO_4 \times \text{Normality} \times 0.745$$

## Determination of Copper

### ELECTRODEPOSITION METHOD

After quickly reducing hexavalent chromium to the tervalent stage with hydroxylamine hydrochloride (hydrogen sulfide reduction is slower), copper is precipitated as sulfide in dilute sulfuric acid solution. The sulfide is then dissolved in nitric-perchloric acid mixture, and the copper may be either electroplated or titrated.

#### EQUATIONS:

1. Copper is precipitated as sulfide:  
 $\text{CuSO}_4 + \text{H}_2\text{S} \rightarrow \text{CuS} + \text{H}_2\text{SO}_4$
2. Copper is dissolved as nitrate:  
 $3\text{CuS} + 8\text{HNO}_3 \rightarrow 3\text{Cu}(\text{NO}_3)_2 + 4\text{H}_2\text{O} + 2\text{NO} + 3\text{S}$
3. Sulfur is oxidized to sulfuric acid:  
 $3\text{S} + 6\text{HNO}_3 \rightarrow 3\text{H}_2\text{SO}_4 + 6\text{NO}$
4. Perchloric acid destroys organic matter and displaces nitric acid:  
 $\text{Cu}(\text{NO}_3)_2 + 2\text{HClO}_4 \rightarrow \text{Cu}(\text{ClO}_4)_2 + 2\text{HNO}_3$

#### PROCEDURE:

Pipette a 10 ml. sample into a 400 ml. beaker and add 200 ml. of water and 10 ml. of (1:1) sulfuric acid. Slowly add 6 g. of hydroxylamine hydrochloride to reduce chromic acid. Pass in a rapid stream of hydrogen sulfide gas for 15 minutes to precipitate copper sulfide. Filter the solution through a 12.5 cm. No. 40 Whatman paper, containing paper pulp, and wash 6 times with a 0.5 per cent sulfuric acid solution saturated with hydrogen sulfide. Discard the filtrate. Return the precipitate and paper to the original beaker and add 25 ml. of nitric acid and 8 ml. of perchloric acid. Wet the paper thoroughly, and evaporate the solution to heavy fumes of perchloric acid. Cool the solution, add 50 ml. of water, and boil out chlorine fumes. Cool again.

Add ammonium hydroxide until the solution is blue, or is alkaline to litmus. Drop in nitric acid until the solution is acid to litmus paper, and then add 5 ml. of nitric acid in excess. Transfer the solution to an electroplating beaker, add 2 ml. of (1:1) sulfuric acid and 0.5 gram of sulfamic acid. Dilute the solution to 150 ml. with water, and electroplate for 20 minutes at 6 volts and one-half ampere, on platinum electrodes. At the end of this time, remove the electrolyte and wash down the electrodes with distilled water. Allow the electrodes to drain on a cloth, then dry for 10 minutes at 100°C in an oven. Cool the cathode and weigh as copper plus platinum. Strip the copper coating in nitric acid, wash the electrode in water, dry and weigh as before. The change in weight is copper, in grams.

#### Calculation:

$$\text{Cu, oz. per gal.} = \text{Weight of Cu, g.} \times 13.35$$

Note—Any lead (not likely to be present) would plate out on the anode as lead peroxide.

### Determination of Zinc

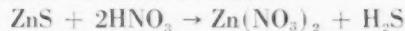
#### GRAVIMETRIC METHOD

After reducing hexavalent chromium to the tervalent stage, copper, lead, zinc, and cadmium are precipitated as sulfides from buffered solution. Copper and lead are separated by electrodeposition. Zinc (and cadmium) are reprecipitated as sulfide, and burnt to the oxide.

#### EQUATIONS:

1. Zinc (copper, and others) is precipitated as sulfide:  
 $\text{ZnSO}_4 + \text{H}_2\text{S} \rightarrow \text{ZnS} + \text{H}_2\text{SO}_4$

#### 2. Zinc is dissolved as nitrate:



#### 3. Perchloric acid destroys organic matter and displaces nitric acid:



#### 4. After plating copper (and lead), zinc is reprecipitated as sulfide, then burnt to oxide:



#### PROCEDURE:

Pipette a 10 ml. sample into a 400 ml. beaker and add 100 ml. of water and 10 ml. of (1:1) sulfuric acid. Slowly add 5 grams of hydroxylamine hydrochloride to reduce chromic acid, then add 5 grams of citric acid and stir until the solid has dissolved.

Add 4 to 5 drops of a one per cent methyl orange solution (sufficient to color the solution red), add ammonium hydroxide to change the red color to gray or green (pH about 5) and follow with 25 ml. of formic acid buffer solution which again turns the solution to a bright red (pH about 2).

Heat the solution to 60-80°C and pass in a rapid stream of hydrogen sulfide for 15 minutes. A dark precipitate indicates the presence of copper or lead, and if the precipitate or coloration is yellow, cadmium is present; white is for zinc, and milky sulfur will appear.

(If no precipitate appears, zinc may be very low. In such case, it is best to add about 5 mg. of lead acetate or nitrate to "induce" the zinc sulfide separation and coagulation.)

Filter the solution through a No. 40 Whatman paper, containing paper pulp, and wash 6 times with a one per cent formic acid solution saturated with hydrogen sulfide. Discard the filtrate. Return the precipitate and paper to the original beaker and add 25 ml. of nitric acid and 8 ml. of perchloric acid. Wet the paper thoroughly, and evaporate the solution to heavy fumes of perchloric acid. Cool the solution, add 50 ml. of water and boil out chlorine fumes. Cool again. Add ammonium hydroxide until the solution is blue (copper) or alkaline to litmus paper. Drop in nitric acid until the solution is acid to litmus paper, and add 5 ml. of nitric acid in excess. Transfer the solution to an electroplating beaker, add 2 ml. of (1:1) nitric acid and 0.5 gram of sulfamic acid. Dilute the solution to 150 ml. with water, and electroplate for 20 minutes at 6 volts and one-half ampere, on platinum electrodes. At the end of this time remove the electrolyte and wash down the electrodes with water. (The electrodes may be weighed for copper and lead contents).

Pour the electrolyte into a 400-ml. beaker and prepare to reprecipitate the zinc (and cadmium) free of impurities. Add 5 grams of citric acid, drop in 4 to 5 drops of methyl orange, make the solution alkaline with ammonium hydroxide and then add 25 ml. of formic acid buffer solution. Heat to 60-80°C and precipitate zinc sulfide with a rapid stream of hydrogen sulfide. (This is the same technique as used in the second and third paragraphs of this procedure). Filter the solution through an 11 cm. No. 40 Whatman paper, containing paper pulp, and wash 6 times with

a one per cent formic acid solution saturated with hydrogen sulfide. Discard the filtrate.

Transfer the paper to a porcelain crucible and dry the paper on the hot plate. Next, place the crucible on an asbestos-center wire gauze which is set above a Fisher burner and heat until the paper has been completely charred and the carbon volatilized. Finally ignite the crucible over an open flame until the residue is yellow when hot, white when cold. If a furnace is available, the paper is first dried on the hot plate, then the crucible is placed in the furnace at 550°C (faintly red) until the carbon has been volatilized and finally heated to 850°C at which temperature the zinc oxide is yellow.

Cool the crucible, brush out the oxide on the balance pan and weigh as zinc oxide, ZnO. Any cadmium present in the original sample will remain with the zinc.

*Calculation:*

$$\text{Zn, oz. per gal.} = \text{ZnO, g.} \times 10.7$$

### Determination of Nickel

#### GRAVIMETRIC METHOD

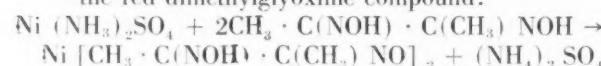
Nickel is best precipitated by dimethylglyoxime in citrate-ammonium hydroxide solution at pH8. Ferric iron and tervalent chromium do not interfere. Copper seriously interferes by delaying the separation of nickel. For this reason, copper is first separated unless it is known that copper is absent, or very low in content.

#### EQUATIONS:

1. Copper is precipitated as sulfide:



2. In ammoniacal solution, nickel is separated as the red dimethylglyoxime compound:



#### PROCEDURE:

Pipette a 10 ml. sample into a 400 ml. beaker and add 200 ml. of water and 10 ml. of (1:1) sulfuric acid. Slowly add a water solution of 6 grams of hydroxylamine hydrochloride to reduce chromic acid. Pass in a rapid stream of hydrogen sulfide for 15 minutes to precipitate copper sulfide. Filter the solution through a 12.5 cm. No. 40 Whatman paper, containing paper pulp, and wash 6 times with a 0.5 per cent sulfuric acid solution saturated with hydrogen sulfide gas. (The paper contains all the copper and lead, and may be used for determination of these elements, as in the procedure for copper).

Use the filtrate for nickel. Insert a stirring rod into the beaker, cover and boil about 15 minutes to volatilize hydrogen sulfide. Add a few drops of nitric acid to the boiling solution (to oxidize iron) then cool the solution to room temperature.

Add 10 grams of citric acid to the green solution, dilute to 250 ml. with water and make the solution just alkaline to litmus with ammonium hydroxide (just enough in excess to detect the odor). Add 25 ml. of a one per cent dimethylglyoxime solution, stir and let

set on the warm plate (60°C) for about 2 hours. (Allow to set on the cold table-top over night if the precipitate is very small.) Filter the solution through an 11 cm. No. 40 Whatman paper and wash the precipitate with warm water until all of the green solution (chromium) has been removed. Discard the filtrate after testing with reagent. Place the original beaker under the funnel and wash the paper with a hot solution of 50 per cent hydrochloric acid until the red precipitate disappears, then wash the paper 6 times with hot water. Discard the paper.

Dilute the solution to 250 ml. with water, add 2 grams of citric acid and make the solution just alkaline to litmus paper with ammonium hydroxide. Heat the solution to about 60°C and stir in 15 ml. of dimethylglyoxime solution (15 ml. are usually sufficient, but if the solution is light blue add 10 ml. more of reagent, and the liquid should then be colorless.) Allow the solution to stand on the hot plate for about 2 hours, then cool to room temperature. Prepare a fritted glass crucible or asbestos-bottomed Gooch crucible, dry and weigh. Filter the solution through the crucible, police the beaker and wash the crucible and red precipitate 10 times with a hot 1% ammonium hydroxide solution. Dry the crucible at 110-160°C for one or more hours. Cool and weigh. The gain in weight is nickel dimethylglyoxime.

*Calculation:*

$$\text{Ni, oz. per gal.} = \text{Nickel glyoxime, g.} \times 2.71$$

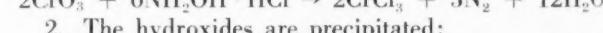
### Determination of Aluminum and Iron

#### HYDROXYQUINOLINE METHOD

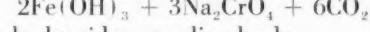
Aluminum, iron, tervalent chromium and copper, zinc and lead hydroxides are precipitated by sodium bicarbonate solution. The hydroxides are dissolved in acid, and then hexamethylene tetramine is used to separate aluminum, iron and chromium from the others. Chromium is volatilized as chromyl chloride, leaving iron and aluminum. These are separated and weighed as quinolates.

#### EQUATIONS:

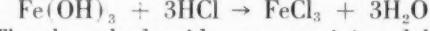
1. A small portion of tervalent chromium is formed:



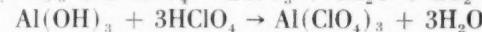
2. The hydroxides are precipitated:



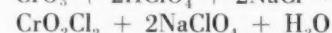
3. The hydroxides are dissolved:



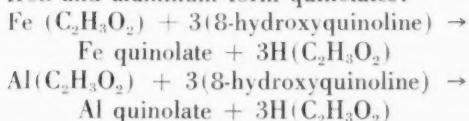
4. The three hydroxides are precipitated by hexamethylene tetramine, then dissolved in perchloric acid:



5. Sodium chloride volatilizes chromyl chloride:



6. Iron and aluminum form quinolates:



PROCEDURE:

Pipette a 10 ml. sample into a 400 ml. beaker and add 100 ml. of water. Add 0.1 gram of hydroxylamine hydrochloride (Eq. 1), and stir. Dissolve 1.5 grams of sodium hydroxide in 20 ml. water and add the alkali solution to the chromic acid solution. Dissolve 8 grams of sodium bicarbonate in 100 ml. of water and pour the bicarbonate solution into a burette. Heat the chromic acid solution to boiling, and slowly drop in the sodium bicarbonate solution until a permanent precipitate forms, and add 5 ml. in excess. Boil the solution for one minute, stir well, and allow the precipitate to settle. Filter the solution through an 11cm. No. 40 Whatman paper and wash out the yellow chromate color with a 5 per cent ammonium chloride solution. Discard the filtrate.

Place the original 400-ml. beaker under the funnel and wash the paper 10 times with a hot (1:4) hydrochloric acid solution. The paper should now be colorless and may be discarded. The filtrate contains chromium, aluminum, iron and if present, copper, zinc and lead. Add 10 grams of ammonium chloride to the filtrate and dilute to 150 ml. with water. Add 5 drops of methyl red solution then drop in ammonium hydroxide until the solution turns yellow (about pH 5) and follow with hydrochloric acid until the solution is just acid. Slowly stir in 25 ml. of a 10 per cent aqueous solution of hexamethylene tetramine. This precipitates ferric iron, aluminum and tervalent chromium as hydroxides. Copper, nickel and zinc remain in solution.

Filter the solution through a 12.5 cm No. 40 Whatman paper containing paper pulp, and wash with a 5 per cent ammonium nitrate solution which contains several drops of ammonium hydroxide. Return the paper and contents to the original beaker, add 25 ml. of nitric and 25 ml. of perchloric acid, wet the paper thoroughly, cover, and evaporate to fumes of perchloric acid. While the solution is boiling gently, drop in quarter-gram portions of solid sodium chloride (about 2 grams) to volatilize the red chromic acid. A brown gas, chromyl chloride, (Eq. 5) forms as the salt strikes the solution. The reaction is completed when no brown fumes appear upon addition of salt, and at this point the solution is no longer red, but may be slightly yellow (chlorine, ferric chloride) or colorless. Cool the solution, add 100 ml. of water and 5 ml. of hydrochloric acid. Warm the solution then filter it through an 11 cm. No. 40 Whatman paper pulp, and wash well with a 5 per cent hydrochloric acid solution. Discard the paper, which may contain silica.

Dilute the filtrate to 150 ml. with water, heat the solution to boiling and boil for 5 minutes to volatilize any residual chlorine gas, then cool. Add 5 grams of citric acid (not tartaric), add a piece of litmus paper and drop in ammonium hydroxide until the solution is just alkaline to litmus. Carefully add acetic acid

until the solution is just acid to litmus paper then add 3 ml. of glacial acetic acid in excess. Remove the litmus paper. Warm the solution to 60-80°C and add 25 ml. of a 2.5 per cent 8-hydroxyquinoline solution to precipitate the black iron quinolate. Allow to stand on the warm plate for about 15 minutes, stirring to coagulate the precipitate. The supernatant liquid should be yellow, indicating excess of reagent. Add more reagent if the solution is not yellow.

*Iron.* Filter the solution through a tared Gooch or fritted glass crucible and wash the beaker and crucible with a hot 0.4 per cent acetic acid solution, 6 times. Dry the crucible for one or 2 hours at 130°-140°C. Cool and weigh as iron quinolate.

*Calculation:*

$$\text{Fe, oz. per gal.} = \text{Fe quinolate, g.} \times 1.527$$

*Aluminum.* Transfer the yellow filtrate to a 600-ml. beaker and dilute the solution to 400 ml. with water. Warm the solution to 60-80°C and add ammonium hydroxide until the solution is just alkaline (pH 7 to 8) to litmus paper, then discard the test paper. Let the solution stand on the hot plate for about 15 minutes (longer if no precipitate is visible). Filter the solution through a tared Gooch or fritted glass crucible and wash the beaker and crucible with a hot one per cent ammonium hydroxide solution. Discard the filtrate. Dry the crucible for 2 to 4 hours (not overnight) at 130-140°C. Cool and weigh as aluminum quinolate.

*Calculation:*

$$\text{Al, oz. per gal.} = \text{Al quinolate, g.} \times 0.784$$

**Determination of Tin in Tin-Lead Anodes**

IODATE TITRATION METHOD

Iron reduces stannic tin to stannous tin. Stannous tin is quantitatively oxidized by iodate-iodide. Iron and small amounts of arsenic, antimony, bismuth, copper and nickel do not interfere. The amount of hydrochloric acid must be controlled.

*Equations.*

1. Lead and tin are dissolved in sulfuric acid:  
$$\text{Pb} + 2\text{H}_2\text{SO}_4 \rightarrow \text{PbSO}_4 + 2\text{H}_2\text{O} + \text{SO}_2$$
$$\text{Sn} + 4\text{H}_2\text{SO}_4 \rightarrow \text{Sn}(\text{SO}_4)_2 + 4\text{H}_2\text{O} + 2\text{SO}_2$$
2. Metallic iron reduces stannic tin:  
$$\text{Sn}(\text{SO}_4)_2 + 4\text{HCl} \rightleftharpoons \text{SnCl}_4 + 2\text{H}_2\text{SO}_4$$
$$\text{SnCl}_4 + \text{Fe} \rightarrow \text{SnCl}_2 + \text{FeCl}_2$$
3. Iodate-iodide liberates iodine:  
$$\text{KIO}_3 + 5\text{KI} + 6\text{HCl} \rightarrow 6\text{KCl} + 3\text{H}_2\text{O} + 3\text{I}_2$$
4. Iodine reacts with stannous tin:  
$$2\text{SnCl}_2 + 2\text{I}_2 \rightarrow \text{SnCl}_4 + \text{SnI}_2$$

PROCEDURE:

Obtain oil-free sawings from the anode. Weigh a 1.000 gram sample and transfer it to a 500 ml. Erlenmeyer flask. Add 20 ml. of sulfuric acid and place the flask on the hot plate. Heat the flask on the hot plate until the action starts, then grasp the flask with a test tube holder and heat the flask directly in the open Fisher burner flame, rotating the flask continually. Continue heating until the sulfur has been driven out of the flask and sulfuric acid condenses in the neck of the Erlenmeyer. (A colorless residue indicates pure lead, or lead-tin alloy. A dark residue indicates antimonial lead.)

Cool the flask on the table top, then immerse the flask in a cold water bath. Add 300 ml. of water to the cold flask, mix and add 80 ml. of hydrochloric acid. Insert an iron spiral (tin-free) into the flask and heat the flask to obtain a rapid evolution of hydrogen. The mouth of the flask may be covered with a 100-ml. beaker. The yellow color (ferric chloride) will soon disappear and the flask should be heated for about 20 minutes after the solution becomes colorless. At the end of this time, remove the flask from the heat, insert several pellets of calcium carbonate and carefully withdraw the iron spiral. Again cover the flask with the beaker and cool the flask in a cold water bath. The solution must be cold at the time of titration.

Prepare a burette containing standard 0.1-N iodate-iodide solution and slip a one-hole stopper over the burette tip. The stopper is the size which fits the Erlenmeyer flask containing the test solution.

Insert several more carbonate pellets into the flask, pour in 5 ml. of starch solution, slip the neck of the flask over the rubber stopper and titrate the solution with the iodate solution. The first permanent blue color (30 seconds) indicates the end of the reaction.

*Calculation:*

$$\text{Sn, \%} = \frac{\text{ml. KIO}_3 \times \text{Normality of KIO}_3 \times 0.05935 \times 100\%}{\text{weight of sample, g.}}$$

A 7% tin-lead alloy will require nearly 12 ml. of 0.1N iodate. This alloy is frequently used for anodes.

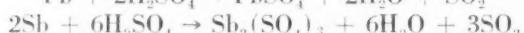
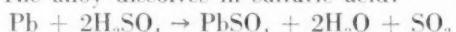
### Determination of Antimony in Antimonial Lead Anodes

#### PERMANGANATE TITRATION

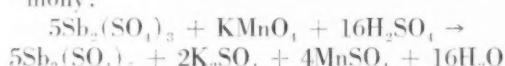
Antimony and lead-antimony alloys dissolve in sulfuric acid, with the antimony appearing as the tervalent sulfate. Permanganate oxidizes the tervalent antimony to the pentavalent state. Arsenic and iron interfere, but bismuth, lead and tin do not.

#### EQUATIONS:

1. The alloy dissolves in sulfuric acid:



2. Standard permanganate oxidizes tervalent antimony:



#### PROCEDURE:

Obtain oil-free sawings from the anode, and use a small magnet to remove any iron particles. Weigh a 1,000 gram sample and transfer it to a 500-ml. Erlenmeyer flask. Add 40 ml. of sulfuric acid and place the flask on the hot plate. Heat the flask on the hot plate until the action starts then grasp the flask with a test tube holder and heat the flask directly in the open Fisher burner flame, rotating the flask continually. Continue heating until the sulfur has been driven out of the flask and sulfuric acid condenses in the neck of the Erlenmeyer. If the heating has been correctly performed the entire sample will be in solution; if the

heating has been too rapid a small white residue (lead sulfate) may be noticed. There should be no dark residue.

Cool the flask on the table top and wait until the flask can be handled with the fingers. Cool the flask below room temperature in a cold water bath then pour in, all in one pouring, 100 ml. of water and shake the flask. Add just 15 ml. of hydrochloric acid and mix well. Heat the flask on the hot plate until air bubbles form, shake once and heat again until bubbles form again. Remove the flask from the heat, add 150 ml. of water and cool in an ice bath to 10-15°C. Titrate, dropwise, with standard 0.1-N potassium permanganate to the first pink coloration which remains for 30 seconds. The titration is conducted very slowly throughout.

*Calculation:*

$$\text{Sb, \%} = \frac{\text{ml. KMnO}_4 \times \text{Normality} \times 0.0609 \times 100\%}{\text{Weight of sample, g.}}$$

A 3% antimonial lead will require nearly 5 ml. of permanganate. "Hard lead" contains 2.75% or more of antimony.

### Determination of Tellurium in Tellurium-Lead Anodes

#### GRAVIMETRIC METHOD

Tellurium sulfate is reduced to the elementary state by sulfur dioxide, filtered from other elements, and weighed.

#### EQUATIONS:

1. Tellurium (valence 4) is reduced to element:  

$$2\text{Te}(\text{SO}_4)_2 + 4\text{SO}_2 + 8\text{H}_2\text{O} \rightarrow 2\text{Te} + 8\text{H}_2\text{SO}_4$$

#### PROCEDURE:

Obtain oil-free sawings from the anode, and use a small magnet to remove any iron particles. Weigh a 2,000-gram sample and transfer it to a 500-ml. Erlenmeyer flask. Add 20 ml. of sulfuric acid and place the flask on the hot plate. Heat the flask on the hot plate until the action starts then grasp the flask with a test tube holder and heat the flask directly in the open Fisher burner flame, rotating the flask continually. Continue heating until the sulfur has been driven out of the flask and sulfuric acid condenses in the neck of the Erlenmeyer.

Cool the flask on the table top, then immerse the flask in a cold water bath. Add 100 ml. of water and 10 ml. of hydrochloric acid. Heat the solution just to boiling, then cool again to room temperature. This minimizes adsorption of tellurium sulfate on the insoluble lead salts. Filter the solution through a 12.5 cm. No. 40 Whatman paper into a 400 ml. beaker and wash the paper and precipitate 6 times with a cold one per cent hydrochloric acid solution. Discard the paper.

To the filtrate add 50 ml. of hydrochloric acid and dilute the solution to 250 ml. with water (12 to 20% HCl). Prepare a saturated solution of sulfurous acid

by bubbling sulfur dioxide into cold water and add 50 ml. of the sulfurous acid to the tellurium solution. Add also about 0.50 gram of hydrazine sulfate, and maintain the solution at 80°C. (thermometer in beaker) for about one hour. Black tellurium, if present, will separate. Allow the solution to cool.

Filter the solution through a tared Gooch crucible, police and wash the beaker with hot water, decanting through the crucible, and fill the crucible 3 times with hot water, draining after each filling. Dry the crucible at 105-110°C. for one hour. Cool and weigh the crucible. The gain in weight is tellurium.

*Calculation:*

$$\text{Te, \%} = \frac{\text{Weight of Te, g.} \times 100\%}{\text{Weight of sample, gm.}}$$

### Determination of Chromium Trioxide and Sulfuric Acid in Anhydrous Chromic Acid

#### PREPARATION OF SAMPLE

Chromic acid is shipped in sealed drums, as a dark red solid, in the form of pieces about three-eighths of one inch in length. The material easily takes up moisture from the air to form a dark liquid and for this reason the drums must be kept sealed.

Before attempting the analysis, the chemist should weigh about 15 grams of the chromium trioxide in order to obtain a rough estimate of the volume required. An ordinary tablespoon is useful in the sampling. The sample should be taken from the solid beneath the surface.

#### PROCEDURE:

Dry, cool and weigh a weighing bottle which is large enough to hold 15 grams of chromic acid. Quickly transfer about 15 grams to the weighing bottle and close it tightly. Re-weigh. The gain in weight is the chromic acid. Carefully transfer the sample to a 400 ml. beaker, using a stirring rod and wash the weighing bottle with water, draining the water into the beaker. Add enough water to half-fill the beaker, stir to dissolve the solid and transfer the solution to a 500 ml. volumetric flask. Dilute to the mark with water, and mix. This solution is used for the chromic acid and sulfuric acid tests and is approximately one-tenth the concentration of a 40 oz. per gallon bath (40 oz. per gallon are equivalent to 300 grams per liter or 150 grams per 500 ml.) 100 ml. of this solution are therefore used for test samples.

*Chromic Acid.* Pipette 100 ml. of the solution into a 600 ml. beaker, and proceed as in the chromic acid determination, above, except that only 200 ml. of water are required. The calculation is different, and the chromium trioxide content should exceed 98 per cent.

*Calculation:*

$$\text{CrO}_3, \% = (\text{p} - \text{h}) \times \text{Normality of KMnO}_4 \times 5 \times .0333 \times 100\%$$

Wt. of sample, gms.

or,

(ml.  $\text{KMnO}_4$  equivalent—ml.  $\text{KMnO}_4$  back titration)  
 $\times \text{Normality} \times 5 \times .0333 \times 100\%$

Wt. of sample, gms.

*Sulfuric Acid.* Pipette a 100-ml. sample of the chromic acid solution into a 400-ml. beaker and add 100 ml. of water. Proceed exactly as in the sulfuric acid, gravimetric method, above. The calculation is different and the amount of sulfuric acid may not exceed 0.05 per cent.

*Calculation:*

$$\text{H}_2\text{SO}_4, \% = \frac{\text{Weight of BaSO}_4, \text{ g.} \times 5 \times 0.4204 \times 100\%}{\text{Weight of sample}}$$

Weight of sample

### Standard Solutions Required

0.1-N POTASSIUM PERMANGANATE SOLUTION. Weigh 6.38 grams of potassium permanganate and transfer it to a 400-ml. beaker. Add 200 ml. of water, stir, let settle and decant the red liquid into a 2-liter volumetric flask. Repeat with 200-ml. additions of water until all the red solid has been dissolved. Dilute the red solution in the volumetric flask with water, up to the mark. Mix well. Transfer the solution to a brown bottle, or wrap paper around a clear glass bottle. Store away from daylight for at least three weeks.

Standardization. Weigh 0.2010 gram of sodium oxalate (Bureau of Standards No. 40) and transfer it to a 400-ml. beaker. Add 150 ml. of water and 50 ml. of (1:1) sulfuric acid. Titrate (room temperature) the colorless solution with the potassium permanganate solution, and continue dropping in the permanganate solution until 29 ml. have been added. Close the burette, heat the sulfuric acid solution to 60°C., and complete the titration with permanganate (about one ml.). Until the solution has a permanent red color (60 seconds). Subtract a blank of 0.05 ml.

*Calculation:*

$$\text{Potassium Permanganate Factor} = \frac{3.00 \times N}{\text{ml. KMnO}_4 \text{ used}}$$

0.1-N IODATE-IODIDE SOLUTION. Carefully weigh 7.134 grams of potassium iodate. Transfer the salt to a 2-liter flask, add about one liter of water and shake until the iodate dissolves. Add, first about two grams of sodium hydroxide and follow with 200 grams of potassium iodide. Shake until all the solids dissolve, dilute to the mark with water, and mix well. If the iodate is carefully weighed, the solution need not be standardized. The amount of potassium iodide is more than is really necessary, but better results are achieved using this amount.

0.1-N FERROUS AMMONIUM SULPHATE SOLUTION. Weigh 40.0 grams of the salt and transfer it to a 400 ml. beaker. Dissolve the sulfate in water and transfer it to a one-liter volumetric flask. Add 10 ml. of sulfuric acid, dilute to the mark with water and mix well. Transfer to a glass bottle. Select a piece of aluminum (low in copper) and drop it into the bottle. The aluminum will prevent the formation of ferric ion, and maintain the factor.

The ferrous sulfate solution is standardized against standard potassium permanganate solution, as written above.

FORMIC ACID BUFFER SOLUTION (FALES AND WARE): To a 2-liter beaker or flask add, and mix, 520 ml. of water, 200 ml. of formic acid, 250 grams of ammonium sulfate and 30 ml. of ammonium hydroxide.

8-HYDROXYQUINOLINE SOLUTION (2.5 PER CENT). Weigh 5.0 grams of 8-Hydroxyquinoline and transfer it to a 400-ml. beaker. Add 10 ml. of acetic acid and place the beaker on a steam bath or warm plate (60°C.). Warm until the solid dissolves then add 190 ml. of water. The solution is stable for a long period of time.

### A Theory for the Chromic Acid Bath

An explanation for the need for two chemicals in the chromic acid bath is offered especially since the analytical method for the determination of sulfate is related to the reason for the presence of sulfate in the bath. As an illustration, let us set up clean platinum electrodes, use a dilute (one oz. per gal.) sulfuric acid solution as electrolyte and pass in current from a six-volt source. Gas bubbles of hydrogen will appear at the cathode and bubbles of oxygen may be observed at the anode. No odor of hydrogen sulfide (sulfur valence minus two) or presence of sulfur dioxide (sulfur valence plus four) will be detected, and no sulfur plates on the cathode. Now drop some copper sulfate solution into the beaker and the hydrogen bubbles will diminish while copper is being electroplated at the cathode; oxygen will continue to form at the anode. Measure also the voltage across the platinum anode and platinum cathode noting that it is about 2.2 volts instead of 6 or 4 or, perhaps, 1.2 volts from the 6-volt source. Finally, note that the beaker still contains the original sulfuric acid.

That is what happens when a dilute solution of sulfuric acid is electrolyzed, and the story of the electrolysis of chromic acid must begin in the same way. To start, discard the sulfuric acid electrolyte, replace it with dilute chromic acid and use the same electrodes and current source. The red solution (hexavalent chromium) turns green (tervalent chromium) and a dirty green precipitate may form which would eventually give a solution containing very little of the original chromium; and if a little copper sulfate were added, the copper would be electroplated at a voltage of about 2.2.

The two acids, chromic acid, and sulfuric acid, have many similar points:

- (1) Formula:  $H_2CrO_4$ ,  $H_2SO_4$
- (2) Insoluble salts:  $BaCrO_4$ ,  $BaSO_4$ ;  $SrCO_4$ ,  $SrSO_4$
- (3) Acid salts:  $K_2Cr_2O_7$ ,  $K_2S_2O_7$
- (4) Ionization:  $H^+ — HCrO_4^-$  and  $CrO_4^- = H^+$ ,  $HSO_4^-$  and  $SO_4^-$
- (5) Periodic Table: Each in Group 6.

The two acids differ on the important property of oxidation and reduction, for, hydrogen peroxide reacts with chromic acid to form a blue peroxide which decomposes to tervalent chromium while sulfuric acid

**TABLE I**  
**Determination of Chromic Acid—**  
**Reproducibility of Results**

Bath	Tervalent		Chromic Acid	
	Chrome		check	
	Content	Determinations		
1 New	0.0 oz/gal	47.4,	47.4 oz/gal	
2 Used	0.83 "	48.2,	48.3 "	
3 "	4.90 "	51.0,	51.0 "	
4 "	.....	48.9,	49.0 "	
5 "	.....	49.6,	49.6 "	
6 "	.....	51.2,	51.2 "	

**TABLE II**  
**Gravimetric and Centrifugal Methods for**  
**Sulfuric Acid in Chromic Acid Bath**

Bath No.	oz. per gal.	$H_2SO_4$	(Centrifuge) ml. of $BaSO_4$
		$CrO_3$ , metric)	
1	40	0.39,0.41	
2	40	0.40,0.40	
3	40	0.46,0.46	
4	45	0.51,0.51	
5	50	0.50,0.51	
6	50	0.51,0.51	
7 (a)	40	0.40,0.40	0.40,0.40
8 (a)	40	0.45,0.45	0.45,0.45
9 (a)	40	0.49,0.52	0.50,0.55
10 (a)	40	0.55,0.56	0.55,0.55
11 (a)	40	0.58,0.60	0.60,0.60

(a) Synthetic Solutions.

eventually gives no change; and chromic acid may be reduced with a zinc-platinum couple, just as easily as in the electrolysis related above, while in neither case is the sulfate ion destroyed.

Two more points of information about tervalent chromium must be noted. In solution tervalent chromium may be in either the green form or the grey form (called allotropic modifications), and the important point about the green form is that it forms complexes (Werner complexes), i.e., by joining with sulfate ion a new complex is formed in which there is neither chromium ion nor sulfate ion.

All of this is used to explain briefly the standard chromic acid plating bath, as follows:

When current is passed through the chromic acid bath ( $H_2CrO_4$  and  $H_2SO_4$ ), the hydrogen ions,  $H^+$  move toward the cathode, while the chromate,  $CrO_4^-$  and sulfate,  $SO_4^-$  move toward the anode. As expected in a sulfuric acid solution, oxygen should be evolved but the oxygen being in an active state (formerly called "nascent oxygen") combines either with chromate ion or chromic acid to form tervalent chromium (like the peroxide reaction mentioned above). This is happening at the anode, where the concentration of sulfate ion is high. At once the tervalent chromium and the sulfate ions form the known complexes, such as:



The cation  $[Cr_2(H_2O)_2(SO_4)_2]^{++}$  immediately migrates to the cathode where it is properly discharged to plate as metallic chromium. This attempts to explain the catalytic action of sulfate ion, and the necessity for its presence in the chromium bath.

### Acknowledgment

The writer wishes to thank Virginia Stewart for check data, and Herman Lembersky and William Goodman for suggestions.

# Electrolytic Polishing of Metallic Surfaces—Conclusion

By Dr. Pierre A. Jacquet, Ingénieur-Chimiste I.C.P., Docteur de l'Université de Paris, France.

## Electrolytic Superfinishing

FOR several years certain American firms have used electrolytic polishing for deburring small pieces of steel<sup>88</sup>, but the systematic application of the process for the superfinishing of machine parts was invented by R. Mondon in the research laboratories of the French Hispano-Suiza Society, well known for its accomplishments in the fields of propulsion and aeronautical arms. The perfection of electrolytic superfinishing was continued by Mondon and his co-workers even though France was occupied by the German army, but the results were only revealed at the end of the hostilities<sup>74, 89</sup>. It is now known that the Germans were attempting to apply electrolytic polishing to the finishing of some pieces of light arms. Although they arrived at interesting results, as we will see, their research remained in the laboratory stage and did not have immediate application.

The idea of using anodic polishing for the finishing of motor parts is simple, but it encountered a fundamental difficulty. This difficulty lies in the necessity of exactly retaining the geometric form of the piece at all of its points. Now if one axis of a piston possesses a simple form (cylinder of revolution) the other working parts, such as the head of the connecting rods and the valves, have complex forms, and one may expect that the metal on the prominent parts will dissolve more quickly than the metal in the hollow parts, from where an irregular variation of the thickness removed in the course of polishing arises. Many baths used for anodic polishing effectively give rise to this phenom-



Figure 48a. Electrolytic de-burring of dental drill. Mechanically cut drill. (Hispano-Suiza photos).

enon and as a result are not suitable for research in this direction. Mondon had to study a large variety of different electrolytes before finding a satisfactory composition. The exact conditions of operation of this new bath depend upon the nature of the metallic material. In general it operates at moderate temperatures ( $30^{\circ}$ - $50^{\circ}\text{C}.$ ) at a current density of 100 to 200  $\text{A}/\text{dm}^2$  ( $930$ - $1860 \text{ A}/\text{ft}^2$ ) or higher than most of the industrial polishing procedures. The tank itself constitutes the cathode, and it is recommended that the liquid be continuously recirculated by pumping.

The duration of the superfinishing treatment depends upon the initial state of the surface and the final state required. In Hispano-Suiza manufacture, polishing is generally done on pieces finely finished or ground on a stone. The valve springs are treated starting with the crude annealed state; the calamine crust is first dissolved in an electrolytic bath at low current density, then this is raised to the normal valve for 1 or 2 minutes to obtain superfinishing.

Measures made on the profilograph, microscopic examination under oblique illumination, and observation of taper sections prove that the microprofile is considerably improved. For example, the maximum

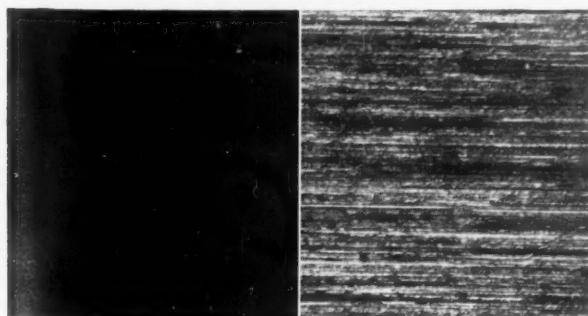


Figure 47—Surface of valve head. Oblique illumination  $\times 1000$ . (from R. Mondon).  
(a) before polishing.  
(b) after electropolishing.



Figure 48b. Same drill after 30 seconds electropolish.

height of the ridges (peak to valley) goes from 3.5 microns to 0.1 micron. Figure 47 shows the complete disappearance of the grinding striations on the surface of an aviation motor valve-head, at a magnification of 100; the electrolytically treated surface is so reflecting that it appears to be completely black under oblique illumination, no reflected light reaching the objective of the microscope.

A short anodic treatment causes the disappearance of larger irregularities such as the marks on the surface of a crudely machined or tool-cut piece (Figure 48).

Among the other advantages of the process we may cite:

1. The solution of the superficial layer, the structure of which is distorted by mechanical work or the chemical composition is modified by thermal effects (decarburization of steel).

2. The exposure of defects lying in the metal itself (lines of inclusions) or those caused by poorly executed thermal or mechanical treatments (internal cracks from tempering, structural heterogeneities, cracks from grinding, etc.). Figure 49 shows three views of pistons superfinished by the Hispano-Suiza process; one is normal, the second shows irregular polishing which results from heterogeneous structure due to incomplete tempering, and the last is covered with a network of fissures appearing as a result of the mechanical grinding. It is to be noted that the defects of pistons 2 and 3 are absolutely invisible after the usual mechanical polishing. The fine grinding cracks are not always shown by the well known test of magnetic iron powder in oil suspension. This is shown in Figure 50a on a steel shaft, part of which has been subjected to a very short electrolytic polishing according to the Hispano-Suiza procedure. This treatment reveals a network of fissures on the surface which does not appear on the untreated section (B). This shaft is later examined in the magnetic metalloscope: the iron powder is fixed on the cracks

already shown in A but not on those of section B (Figure 50b). This portion nevertheless is fissured as is proven by a later anodic polish. Examination by fluorescence is no more successful. The reason why neither the magnetic powder or the fluorescent liquids do not show the fissures on the crudely finished part is because of their extreme fineness (about 0.001 mm in width). The electrolytic superfinishing causes a preferential solution of the steel about the edges and thus exaggerates them considerably, so much that they become visible to the naked eye.

The heterogeneities of structure due to a thermal or tempering treatment improperly conducted, can only be detected by a macrographic examination of the piece, which is impossible to do systematically in a manufacturing process. A rapid test of hardness will give uncertain results considering that it will be run at random on the surface.

The control of Stellite valve heads by electrolytic superfinishing should also be mentioned, as defects of continuity on Stellite are clearly shown.

3. It has already been stated under the influence of electrolytic polishing on fatigue phenomena that mechanical polishing introduces superficial stresses in the pieces which are evaluated by X-ray diagrams; they may reach high values. The change of these stresses as a function of the thickness of steel removed in the course of electrolytic superfinishing has been studied<sup>90</sup>. A tempered steel shaft finely finished on a grindstone contains compression strains of the order of 55-60,000 p.s.i., which diminish in relation to the thickness of the surface layer dissolved and become practically non-existent when about 25 microns have been removed. Sometimes the removal of much larger

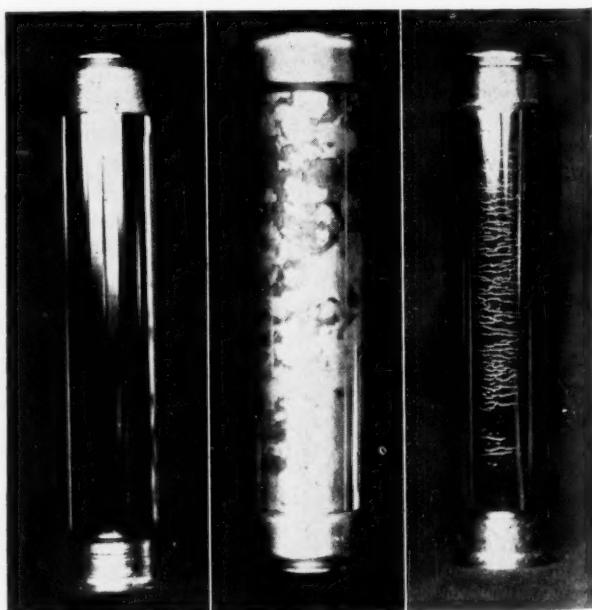


Figure 49. Piston rod of aircraft engine. Defects shown by electrolytic superfinishing.

- (a) Good rod.
- (b) Rod whose surface shows dull spots characteristic of incomplete tempering.
- (c) Rod showing fissures on the surface caused by poorly executed grinding.

quantities of material discloses new stresses which are tension strains.

The relationship existing between the superficial stresses and the disturbances of the crystal network in the course of mechanical finishing are not well known. It is only known that the stresses may be quite high even when the work on the surface has been done under the most gentle conditions. Thus, some steels superfinished on a stone have compression strains of the order of 140,000 p.s.i.<sup>72</sup>. On the contrary, electrolytic superfinishing not only does not create stresses but eliminates those which already exist.

The fatigue of machine parts subjected to alternating forces is certainly influenced by all of the characteristics of the material in the vicinity of the surface, but the exact part played by each of these properties (structure, stresses, microprofile) is still ignored. It is generally admitted that compression stresses raise the limit of endurance to fatigue and this is why specially conceived techniques are used to cause the appearance of these stresses on the surface of machine parts subject to fatigue, one of these being shot peening of springs. Numerous laboratory tests and practical results have shown that valve springs finished by electro-polishing are quite resistant to fatigue, even though they no longer contain superficial stresses. It is true that the treatment is, as stated before, a very efficient method of control as all of the springs showing surface defects are eliminated from the tests. One then asks whether the compression stresses do not act in an indirect manner such as reducing the tendency toward microdefects of the surface which start failure fissures. The method which is designed to cause this compression to appear may also have the effect of warping the microdefects.

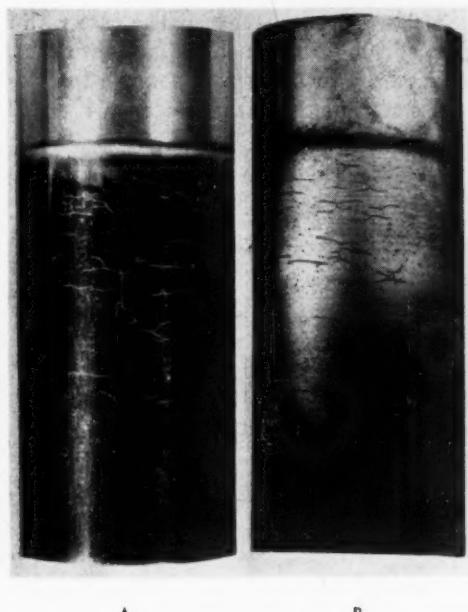


Figure 50. Steel shaft mechanically ground under poor conditions. Area B is as ground, area A is after electropolishing the ground surface. 1x.

- The cracks from grinding are visible on the electropolished area, but not on the "as ground" area.
- Magnetic crack detection of the same sample. Note that no cracks are detected on the "as ground" area.

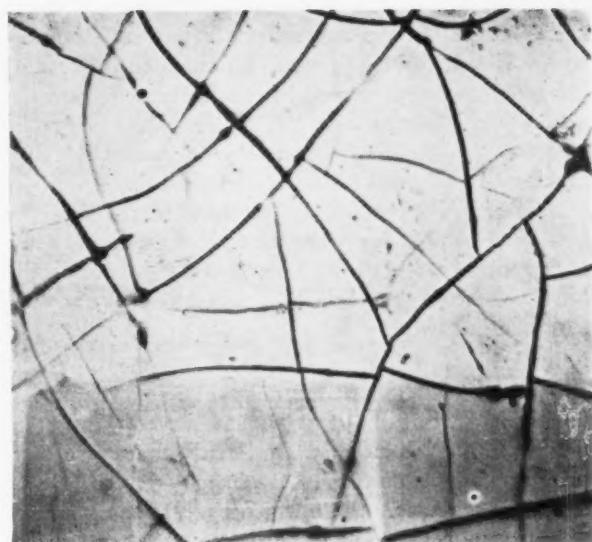


Figure 51. Fissure network of a hard chrome deposit shown by electropolishing in an aceto-perchloric bath x400.

4. Results previously discussed have shown an appreciable improvement of the friction properties of some electrolytically superfinished steels, but the experiments are still too few to allow any generalization. This favorable effect is without doubt due to the increase of the bearing coefficient resulting from the removal of the micro ridges, as indicated by the fact that the initial period of grinding is suppressed: the coefficient of friction is constant while it decreases in the first minutes on a mechanically polished surface. The very slight wear of the friction piece also supports this interpretation.

It was these particular advantages of electrolytically polished surfaces which the Germans were attempting to apply during the last war, for the resolution of the problem of preventing the dragging of stainless steel bushings in light arms. Electrolytic polishing of the cartridge chamber by means of an aceto-perchloric bath gave complete satisfaction, but the ultimate course of the war did not allow that the process be used on a manufacturing scale<sup>91</sup>.

Electrolytic chromium in the form of hard or porous deposits is actually widely used in ferrous metals to increase their resistance to wear, reduce friction and facilitate greasing. As previously noted, this type of finish may be realized with electrolytically polished surfaces, which shows double interest in good adhesion and very flat surfaces. The electrolytic polishing or superfinishing of deposited chromium in place mechanical polishing may also be visualized. Actually, the electrolytes for polishing chromium cause the appearance of fissures and porosities in the deposit<sup>92</sup>. In other words, the process is an excellent method for obtaining a very flat surface and a "porous chrome" simultaneously (Fig. 51).

5. The resistance of steels to corrosion is clearly improved by electrolytic superfinishing. The improvement arises from the perfection of polishing, the disappearance of superficial impurities and cold worked layers, and probably also to the presence of a film of passivation. Steel surfaces thus prepared may be pre-

served for a long time in ordinary atmosphere without signs of rust. Intake and exhaust valves superfinished by the Hispano-Suiza process and mounted in a racing car motor, were preserved in excellent condition after a long period of operation. It is also known that stainless steel fins used in high pressure steam turbines are much more resistant to corrosion than the same material finished mechanically. In tests in the vapor of boiling sea water the latter are very strongly corroded at the end of a few days while after electrolytic polishing they remain unattacked for several weeks and even several months.

In conclusion it may be stated that the industrial application of electrolytic polishing for the superfinishing of machine parts opens a very important field. Results already obtained in France are very promising but numerous problems remain to be studied, particularly those which concern the influence of the treatment on the surface stresses and on the endurance under fatigue. Aside from its apparent practical interest, electrolytic superfinishing ought to lead to a definite aid in the realization of the well defined and reproducible states of surface necessary for a better understanding of the rather complex phenomena such as friction, wear, fatigue, lubrication and the corrosion of machine parts.

#### **Electrolytic Polishing as an Intermediate Stage in Manufacturing**

Up to this point the practical applications of electrolytic polishing which have been discussed have only replaced the finishing methods using the known mechanical methods. New observations which are still fragmentary and consequently require confirmation and extension, appear to open up a quite unexpected field of application of great importance.

It is known that electrolytic polishing with the goal of decoration affects the quality of the metallic material which composes the treated objects: all of the heterogeneities are effectively shown in the course of the anodic process, when they would normally be camouflaged during the normal mechanical polishing. Surfaces obtained in this way now show more or less intense and more or less numerous defects, which generally show in the form of pits and which evidently impair the quality of the finish. Among the heterogeneities composing the surface defects, non-metallic inclusions of material appear to be most annoying. Some of these inclusions arise from the mode of preparation of the metal or alloy in the ingot form, such as oxides, silicates, sulfides, etc., in steel, cuprous oxide in copper, etc. Others appear in the course of the transformation of the ingots into the intermediate products (sheets, strips, wire, blanks, etc.) and arise either as dust from the manufacturing tools (rolls of the mills), or above all, oxides formed during the annealing treatments between the forming operations and incompletely removed by chemical pickling.

One would think that electrolytic polishing performed at some stage in the production of the intermediate product, or on the piece made from this intermediate product, would suffice to eliminate superficial heterogeneities and impurities. This new treatment

will also play the role of pickling more efficiently than the usual chemical pickling, for in contrast to the latter it uniformly dissolves the material and may be prolonged as long as is necessary without appreciably modifying the microgeometry of the surface. Experiments conducted in conjunction with R. Halut have shown that this goal was reached<sup>93</sup>. Thus, electrolytic polishing of 70-30 brass before the last pass in cold rolling allows the formation of very thin sheets free from surface impurities, and which consequently are very easily polished either by the mechanical or electrolytic method. Furthermore, the anodic treatment of a german silver plate before the cold stamping operation gives a piece with a pure surface and which will take an excellent polish.

These results are already of interest, for they prove that the quality of an intermediate product or finished product may be improved by electrolytic polishing at a conveniently chosen stage in the manufacture. It has been revealed that this is not the only result obtained and another of more importance may be shown: *in many cases anodic treatment of the material increases its capacity for plastic deformation in the cold*<sup>94</sup>. Thus it becomes possible to eliminate all of the annealing between cold rolling, die work, stamping in some cases.

Cold forming is accompanied without the appearance of fissures or cracks even though the amount of cold working obtained is appreciable. Brass cold rolled after electrolytic polishing becomes so hard that it is very difficult to pierce it with ordinary tools. Figure 52 shows as an example a deep stamping effected without annealing, starting with an anodically treated plate of german silver. Normally this stamping requires a total of three annealings before reaching its final form. Analogous results have been obtained with certain grades of brass, stainless steel, 13% chrome steels, and nickel steels. The case with molybdenum is still more unusual. It is known that sheets of this metal are most often impossible to cold form: from the start numerous fissures appear on all sides of the plate (Figures 53a and 53b). On the contrary, after electrolytic polishing of sufficient duration to remove twenty to thirty microns, molybdenum may

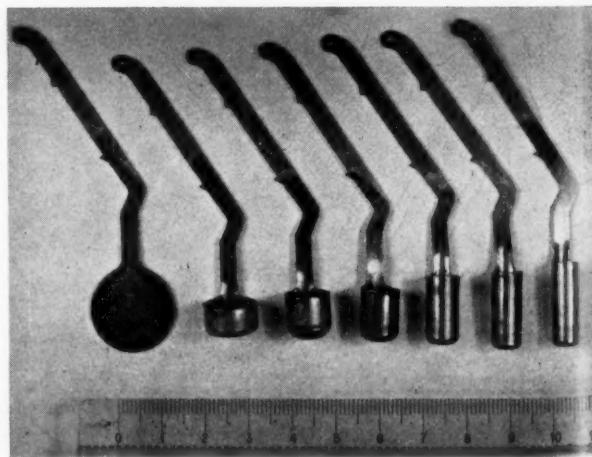


Figure 52. Nickel silver telephone jack obtained by cold swaging in six passes without any intermediate annealing. The plate was electropolished before swaging.

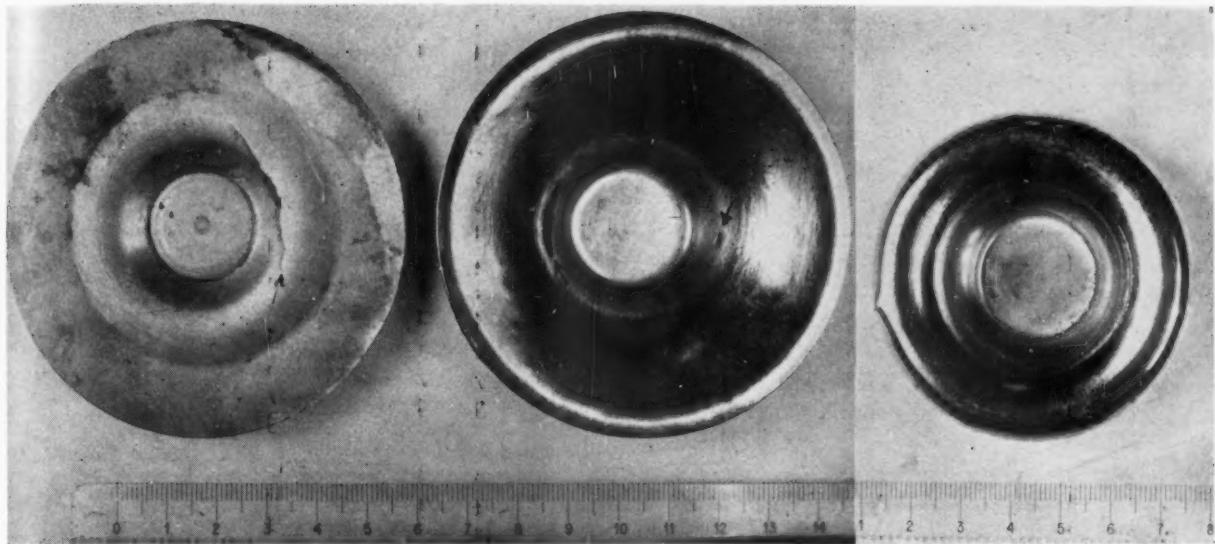


Figure 53. Drawn molybdenum sheet. Left—ruptured in first pass; Center—ruptured in second pass; Right—completed piece obtained without rupture by starting with an electropolished sheet. Samples by M. Nineuil.

be spun into relatively complicated forms (Figure 53c).

The properties of the surface of metallic materials, from the viewpoint of plastic deformation in the cold, are of hitherto unsuspected importance. The exact causes of the observed results are still hypothetical. One might think that electrolytic polishing is effective for one or more of the following reasons:

- a) Suppression of the burrs of metal and fissures on the edges of the sheet or the plate.
- b) Elimination of superficial microfissures and irregularities.
- c) Complete solution of the perturbed layer and the chemical impurities on the surface and in the immediately adjacent zones.
- d) Liberation of gas included near the surface.
- e) Improvement of the conditions of lubrication during the formation as a result of the surface properties.

It is probable that the mechanism which leads to the stated improvement is not identical for all metals and alloys. In the case of 13% chrome steel formed by cold punching, the thick starting plate is always covered with a film of oxide. Simple pickling, although it removes the largest part of this crust, is incapable of removing the particles of oxide which have penetrated more or less into the interior of the alloy. These particles are very easy to distinguish after an incomplete electrolytic polish for they appear as dull areas located in a bright background. Complete elimination of annealing treatments between milling passes is only possible if all of the oxide has been previously removed by the anodic method. As a result, a relationship seems to exist between the absence of oxide inclusions and the improvement of the capacity for cold deformation of 13% chrome steel. Each of these inclusions, especially when it is found in the vicinity of the surface, should favor the appearance of fissures when the metal reaches a certain degree of cold working. The case of brass is most difficult to interpret, for it is not possible to show a higher concentration of impurities or inclusions at the

surface than in the mass of the material. For molybdenum, a micrographic examination and a study of the X-ray diffraction diagrams has shown clear enough structural differences between the layer near the surface and the mass of the plate, but it is not certain that this is sufficient to explain the favorable effect of anodic polishing. Here again the polishing removes the superficial oxides and it is known that molybdenum absolutely free of oxide is much more malleable. It is not yet known, however, whether these stated results are valid for all of the types of molybdenum furnished by industry.

The explanation for the elimination, thanks to anodic polishing, of superficial cracks and fissures and microgeometric defects capable of provoking a "notching effect," is sufficiently attractive to further research. This, in particular, accounts for the famous experiments of Joffé, who has shown the considerable increase in mechanical resistance acquired by an ionic crystal such as sodium chloride, when the experimental set-up allows the removal of their microfissures which appear on the surface subject to the forces. It is true that Joffé's experiments deal with a fragile material, or with a material in which the failure is not accompanied by any plastic deformation. However, the analogy with a metal becomes possible in the case of molybdenum which in fact shows the beginning of rupture starting with the first signs of plastic deformation. We have also seen in the applications of electrolytic polishing to the study of mechanical properties that, according to Crussard the failure load of a fragile steel is appreciably increased after electrolytic polishing causes the removal of the micro notches on the surface.

These elementary discussions are only intended to show the complexity of the problems based on the influence of the surface on the property of cold deformation of the metallic body, which are fundamental from the practical or even theoretical point of view. We hope that the physicists and metallurgists, each with his particular methods, will lean towards these new and mysterious problems.

Finally, we will mention one other practical application actually appearing to have been developed in the U.S.S.R. and deserving a remark. It is the simultaneous use of an electrical current, an electrolyte and a saw for cutting very hard and very thick metallic materials<sup>95</sup>.

### General Conclusions

Arriving at the end of the article, perhaps long, but nevertheless very incomplete, we hope we have succeeded in interesting the reader in this new method of finishing metallic surfaces by electrolytic polishing. It is shown that this method is not limited, as believed by some technicians, to the beautification of articles as a complement to conventional mechanical polishing, but that in reality it opens many scientific and industrial possibilities in the important fields of plastic deformation, corrosion, electronics, and electroplating, to mention a few of those in which the state of the surface is a fundamental factor in the behavior of the metal.

The author, who for more than fifteen years has devoted the greater part of his activity to the study of metallic surfaces, will reply with the greatest pleasure to suggestions and explanations which are raised in the article, each of which will be acknowledged.

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# West Coast Electroplating Industry

By Elburn Marcum, E. I. DuPont de Nemours Co., Inc., El Monte, Calif.



**E**LCTROPLATING on the West Coast has made great strides during the past few years. It has departed from the slow, old-fashioned methods and solutions to a modern, mechanized industry. The success enjoyed by manufacturers, aided by our modern job shops, is probably due to the fact that most of the plants were designed and built during recent years and employ the most recent equipment. In most cases they have not outgrown the original plant layout, and therefore operate with maximum output, with a minimum of effort.

The use and close control of modern solutions and techniques accounts for the high quality of work. The greater volume of items being plated has allowed both the manufacturer and job plater to mechanize some of his plating equipment and thus reduce unit cost.

In many cases we can compete with established eastern firms, both as to quality and economy of operation. Some manufacturers have developed their technique to the point that they can produce on the West Coast, ship their products east and still be competitive with eastern manufacturers. This is not confined to manufacturers who do their own plating operations, as a large portion of the work done by job shops finds its way into eastern markets.

Before describing some of the more important plating activities, it would be well to give a general idea of some of the history of the industry on the West Coast.

At the turn of the century, electroplating was confined almost entirely to the lighting fixture business and bicycle parts. In the Los Angeles area, five plants were in operation, including two bicycle manufacturers. The plating solutions at that time consisted of (1) grey nickel, (2) cyanide copper made from copper carbonate and imported potassium cyanide, (3) acid copper, and (4) silver and gold. This condition continued for some years with the lighting fixture business dominating the field. By 1913 or 1915 the

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This paper was presented before the Pacific Chemical Exposition in San Francisco in November 1949, and is included in this issue because of the increased interest in the West Coast as a new center of plating activities.—ED.

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lighting fixture business had grown until one plant in San Francisco, for example, employed several hundred persons in their polishing department alone.

Electroplating was curtailed during the first World War, but after the war considerable expansion occurred. The center of activity began to shift from San Francisco into the Los Angeles area, where it has remained to date.

Around 1925 cadmium plating was introduced, and considerable advancement in the industry occurred when chrome plating was introduced in 1926 or 1927. By 1930 there were 280 operating plants, consisting of both manufacturers plating departments and job plating shops. Incidentally, 57 of these plants are still in operation.

In 1935 the first bright zinc installation was made on the West Coast. In 1937 bright nickel was introduced, followed in 1938 by high speed copper plating. Some installations on all types of newly developed solutions occurred prior to 1942, but war production demands curtailed nickel, copper, chrome and most other metals, to essential uses.

Plating activities shifted to war production between the years 1942-1945. Zinc, cadmium and tin were in common use with small, but essential, operation of copper, nickel and chrome.

The expanded uses of zinc, cadmium and tin for war production is of interest. The most important installation on the West Coast occurred when *Norris Stamping and Mfg. Co.* set up a 37,000 gallon zinc plating solution in a full automatic machine to electroplate Navy powder cans. This installation was unique in that the plant was designed and set up prior to the development of a plating bath which would give a deposit sufficiently ductile to withstand the drawing operating on the can after plating!

The can was initially formed in four stamping operations from a 22" blank. After the fourth stamping, it measured 6 $\frac{1}{2}$ " i.d. x 16" long. It was then plated and drawn, or rolled as the operation was later called, to a length of 31" in one operation. The zinc was used as a lubricant during the drawing and acted as a protective coating after complete fabrication. The original plate thickness was approximately .001" on the outside and .0005" on the interior surfaces. After drawing, the plate thickness was approximately one-half of these values.

The problem of working out a suitable zinc plating formulation to do the job in question was completed within 10 days, and the remaining operating problems were worked out in the Norris plant. In addition to this ductile zinc process, Norris operated an additional 18,000 gallons of bright zinc in a full automatic unit, which was used to plate shell cases.

Norris Stamping & Mfg. Co. sub-contracted the powder can lids and rings to *Bowers Mfg. Co.*, Los Angeles, who set up another 10,000 gallons of bright zinc in a full automatic unit. Bowers produced as many as 22,000 lids in a 24 hour day.

*Cadmium & Nickel Plating Co.* in Los Angeles set up a small automatic unit to plate bomb fuse heads to rigid specifications. They plated over one million of these with no returned plating rejects. *Douglas Aircraft* also operated 5000 gallons of bright zinc, while *Super Cold Corp.* electroplated mess kits, using tin, in a full automatic unit.

Most of the plating for the aircraft industry was done by job plating plants who expanded rapidly and geared themselves for mass production.

Immediately after the end of World War II, cadmium and especially zinc plating dropped off sharply, but was quickly replaced with installations in bright copper, nickel and chrome, to handle work in the decorative field. Out of the war came West Coast manufacturers and job platers with "know how", initiative and modern plants, streamlined for mass production. Conversion of war plants to domestic production furnished the quantity of materials necessary to keep the plating plants in operation.

To give an idea of the expansion and shift to modern high speed solutions since 1945, the total solution gallonage was increased to 180% by December 1946, 290% by December 1947, and at the present time is approximately 3 $\frac{1}{2}$  times the total gallonage of 1945. This reflects, in general, the modernization which has taken place during the past 4 years.

In order to arrive at any kind of a picture of the amount and types of plating, and centers of activity, we will again employ solution gallonages.

There are approximately 660,000 total gallons of plating solutions of all types in the eleven far western states. Seventy-six per cent (501,000) are of the most modern types of solutions and 12% consists of such solutions as dull nickel and duplex copper, which are used where they are more adaptable than the so-called modern type. If we break down the total to determine the amount of the various plating baths for each metal, we find 33% in nickel, 23% in copper, 21% in chrome, 12% in zinc, 8% in cadmium, 2% in

brass and bronze, and 1% divided between tin, silver and gold.

The centers of plating activity can be determined by the distribution of plating solution gallonage. By this method, we find 74% in Southern California, 20% in the San Francisco Bay area, and the remaining 6% distributed between the northwest and remaining areas in the eleven western states.

The number of plants engaged in electroplating or related departments in these western states, amounts to approximately 1200, with over 1000 in California. In the Los Angeles area, the job plating shops outnumber the manufacturers plating departments by about five to two. This indicates that job shop operations constitute a large portion of the activity. It is estimated that the gross business of these job plating plants approximates 7 million dollars annually, based on present business.

In general, job shop activities are divided into two classes. The first and most important is finishing of production work from manufacturers. The second and less important but necessary operation, is refinishing of used materials. This latter is usually a smaller operation involving only one or a few items from any given customer, and is an "over the counter business". In our brief description of some of the job shop activities, we will confine our discussion to plants of the more important class.

To give a clear picture of the work done by the job shops would be as difficult as describing all the shades of color in the spectrum. One of the job shop owners indicated that he has more than 1000 customers (manufacturers) on his active list, most of whom furnish many different items for metal finishing. A partial list of identifiable items found in one of the job shops during a recent visit will indicate the variety of work handled.

- (1) Radio and television chassis and parts.
- (2) Ball point pen cases and clips.
- (3) A variety of furniture hardware.
- (4) A variety of builders' hardware.
- (5) Machine screws, bolts and nuts.
- (6) Wire products, such as refrigerator trays and planters' specialties.
- (7) Nails.
- (8) Auto accessories, wheel rims, curb alarms.
- (9) Children's items, such as jacks and spurs for cowboy boots.
- (10) Lamp brackets and floor lamp parts.
- (11) Electrical outlet and connector boxes.
- (12) Springs.
- (13) Kitchen utensils.

Many unidentifiable items are not included. The amount of each item may vary from a few to many thousands, or from a few pounds to several tons, depending on the item. One striking thing concerning this list of items is that it would have to be almost completely revised on visiting the plant several days later.

#### **Specialty Plating Plants**

Some of the plants are not set up to handle such a variety of work but may instead specialize in certain

fields, such as plating zinc die-castings and brass castings in large quantity on automatic machines. In this type of plant, it is uneconomical for them to operate unless like parts number in the tens of thousands. This type of plant contributes largely to a desirable overall competitive market for the products, since a large amount may be finished at a minimum cost.

One plant which falls in this category operates semi-automatic buffing equipment, full automatic cleaning line and semi-automatic copper and bright nickel with the chrome in a full automatic.

Another plant of interest covers a much wider field but specializes in barrel plating of small parts, using zinc, cadmium, brass, nickel and chrome. In their zinc and cadmium lines, they may process as much as 16 tons in an 8 hour day. The pieces may number over one million. This plant also operates a full automatic machine on zinc and cadmium and may electroplate as high as 40,000 pieces/day on each. Items as large as television chassis may be plated on these machines. In addition, they operate a semi-automatic and several hand operated tanks, using bright nickel and one bright copper, brass, chrome, silver, gold, tin, and dull nickel.

### **General Job Plating**

In contrast, especially to the first plant described, are other shops of importance that do a great variety of work but are geared to handle smaller quantities of any given item. This means that a manufacturer may produce in any quantity and find a job plating plant with the equipment geared to handle that quantity efficiently and at a minimum cost.

One plant of this kind operates about 35 different plating tanks. During a typical two-shift day they may plate 30,000 pieces in 10-15 different finishes, and 100 different items may be represented.

Other operators may have 4 or 5 tanks and plate only a few hundred pieces, but in some cases these operations are completely satisfactory because of the items involved and quantities available.

### **Manufacturers' Plating Operations**

In our discussion of the manufacturers who do their own plating, it might be well to point out that metal finishing is done in these plants primarily because they have sufficient volume to maintain such a department. Since many of these manufacturers produce a limited number of items but a large volume, the work is easily adapted to full automatic or semi-automatic operation, whichever is the most economical procedure.

In order to present some sort of a picture of the position of electroplating in the various manufacturing fields, it would be well to describe some of the specific plant operations according to the field in which they operate. We have manufacturers of builders' hardware, auto parts and accessories, electrical equipment, ranges and refrigerators, novelties, household items, wire goods and many others.

In the builders' hardware field we have plants which specialize in manufacturing of locks, bathroom fixtures, plumbing fixtures, doorknobs and general hardware.

The manufacturers of locks, such as *Schlage Lock Co.* in San Francisco, *Hilgren Mfg. Co.* and *Kwikset Lock Co.* in the Los Angeles area, all operate semi- or full-automatic plating equipment, along with still tanks and barrels. A wide variety of parts are plated using copper, nickel, chrome, brass, bronze, zinc and cadmium.

*The Hall-Mack Co.* in Los Angeles is reported to be one of the largest manufacturers of bathroom fixtures in the world. This is one case where development of technique has allowed such economical operations that they are competitive with eastern manufacturers on an eastern market. They operate their own zinc die-casting plant. The metal finishing operations include some semi-automatic buffing, automatic cleaning line and semi- and automatic plating.

In the plumbing fixture field, considerable local competition has furnished the incentive to improve technique and reduce cost so that some plants can now ship east and give considerable competition on the eastern market. Operations in these plants follow the same pattern with the semi- and full-automatic equipment. Plating is confined to bright copper, nickel and chrome.

Gross business done by manufacturers of builders' hardware other than locks, plumbing and bathroom fixtures will total well over  $1\frac{1}{2}$  million dollars per year. A wide variety of finishes are used in this field and will include copper, silver, brass, bronze and oxidized finishes of each of these metals along with nickel and chrome. One plant specializes in manufacturing of door knobs, and is reported to be one of the world's leading producers of both metal and glass types. This company has its greatest volume of sales east of the Mississippi. Their operations are unique in that they fabricate their metal door knobs of aluminum in permanent mold castings and plate with all popular metals. Considerable work was necessary to develop a satisfactory plating technique but they now enjoy the benefits of using aluminum castings as a wider range of design is obtained than possible with pressed units. They are less expensive than cast brass and shipping costs are reduced because of light weight.

Another important field is automobile parts and accessories.

*U. S. Spring and Bumper Co.* in Los Angeles was the first plant on the coast to supply original equipment to the automotive trade. They secured their first contract about 1927 from the Ford Motor Co. to supply bumpers and springs. The company has grown steadily and now furnishes parts for Ford, Mercury, Studebaker, Chevrolet, Plymouth, Pontiac, Buick and Dodge. Bumpers constitutes the major portion of their operations. Preparatory to metal finishing, the bumpers are pickled in acid to remove mill and furnace scale in a full automatic machine. The next step is mechanical polishing first in a radial machine for the ends and then in a full automatic line for

the remaining unpolished surfaces. A final hand polishing is done for uniformity of results. Electrocleaning and electroplating is done batchwise by placing the bumpers on large racks which are moved from tank to tank using an electric hoist on a monorail system. Bumper guards are plated in a full automatic machine.

The Calnevar Co. manufactures auto parts, and specializes in wheel discs, hub caps and wheel rims. On the basis of their present production and in the right combination they could supply wheel covers, discs and chrome rims for nearly 500,000 cars per year. They do the complete operation from forming thru electroplating. Their metal finishing department includes some automatic polishing equipment and semi-automatic plating machines. Bright copper, nickel and chrome are used. Final plate meets automotive specifications.

There are several companies, namely S & M Lamp Co. and Lumidor Mfg. Co. who manufacture fog lights. The most recent company to invade the automotive field is Cannon Electric Development Co. Their operations are important, as they obtained the first prime contract on the West Coast to produce decorative zinc die-cast hardware. Their operations include complete fabrication from casting thru some sub-assembly. Since this company has done die cast work for many years in the electrical connector field, which will be mentioned later, they had basic equipment and considerable knowledge of the required operations. They do full automatic buffing operations on odd shapes using custom built machines. Cleaning operation prior to plating is handled in a full automatic machine. Bright copper and nickel is done in semi-automatics. Final steps include chrome plating, drying, inspection, sub-assembly if necessary, and packing for shipment. Incidentally, these parts must meet automotive specifications as to plate thickness. Results of their operations after working out some initial problems were so good that their contract was extended to allow them to supply not only West Coast requirements but those of the Southwest.

Another field to consider is that of electrical equipment. The major manufacturers produce special plugs, conduit boxes and conduit tubing. Again Cannon Electric Development Co. enters the picture as they are said to be the largest manufacturers of special electrical connectors in the United States. The cases for these plugs are mainly aluminum die-castings. These castings are electroplated with tin as a protective coating by mass production methods in a horizontal barrel.

One manufacturer fabricates and electroplates con-

duit boxes. The plating operations are handled in a full automatic machine. They merely load the fabricated but raw steel boxes on one end and take them off of the return side, zinc plated, dried and ready for packing.

A recent addition to West Coast activities is the installation of new plants for the fabrication and metal finishing of conduit tubing. These plants set up finishing equipment which is believed to be superior to any other now in use. They are completely automatic and have a combined capacity to handle from 160,000-200,000 linear feet of conduit tubing per 8 hour day. The sizes of tubing processed are  $\frac{1}{2}$ ",  $\frac{3}{4}$ ", 1",  $1\frac{1}{4}$ ",  $1\frac{1}{2}$ " and 2" diameter. The automatic equipment cleans the tubes inside and out, zinc plates outside, rinses, dries, automatically sprays enamels inside, bakes, and delivers finished tubes without intermediate handling.

Another field in which electroplating is done is in the manufacture of ranges and refrigerators. Well known firms like O'Keeffe & Merritt and James Graham Mfg. Co., who manufacture ranges, have set up extensive facilities to electroplate stove parts such as grills and range tops. All have some automatic buffing and plating equipment.

The West Coast is also a major factor in the novelty and trophy field. We produce approximately 23% of all the trophies and approximately 30% of all the statuary novelties in the United States. The novelties include such items as figures of animals and objects, book ends and ash trays. These articles are finished in copper, silver, bright brass, bronze or oxidized finishes of the same metals. Trophies are usually finished in gold.

In the field of household items, General Electric in Ontario, Cal., produces large quantities of electric irons and do their plating in the latest of full automatic equipment.

One Los Angeles firm produces dime store variety kitchen utensils and plates using copper, nickel and chrome in a specially adapted full automatic machine.

A large quantity of fabricated wire goods is electroplated. In this group are refrigerator trays which are zinc or copper-nickel-chrome plated. Other items such as planters' specialties are usually finished in bright copper or brass and lacquered.

As long as the present general attitude toward improvement is maintained by those engaged in electroplating activities, the West Coast continues to make progress, both as to the quantity of materials produced as well as quality.

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gratefully received and the sender's name will be kept confidential, if desired.

### Streaking in Nickel Plating Die-Castings

**Question:** How can I cold bright nickel plate assembled zinc die-castings without blackstreaking? The parts are hollow and recessed. They are burnished before assembly and require only .0001" for appearance but streak badly when using the regular bright copper—hot bright nickel procedure. Can you suggest a better way to do these parts?

M. R. C.

**Answer:** Streaking of die-cast parts in bright nickel solution occurs when the base metal has not been completely covered with copper, including the deep recesses, prior to the nickel plating. To completely cover the parts with copper it may be necessary to plate for a longer period of time or use a special racking and anode arrangement, but if a complete coverage of copper is obtained it will be possible to nickel plate successfully without streaking. There is also available for plating on die-castings an alkaline nickel bath which does not require a copper undercoating, which may be suitable for your work. Names of the firms that can supply this material are being forwarded to you.

### Plating Soft Soldered Articles

**Question:** In plating soft soldered instruments we have found that many times it is impossible to get all of the acid from the soldering flux out of the soldered joints. This later leads to bleeding out and discoloration after the parts are gold plated and lacquered. The parts are thoroughly degreased after soldering, but we get this trouble off and on. Any informa-

tion you can give us on how to overcome this problem would be appreciated.

A. S. J.

**Answer:** Degreasing alone is not always the best method for removing excess soldering flux from soft soldered joints. While degreasing will remove any greasy material in the flux, it is essential that the degreased parts be soaked in hot water for a period of time to dissolve away the acid salts contained in the soldering flux. Sometimes several rinses in clean, hot water will be required. After this a neutralizing dip in the regular hot alkali cleaner is helpful, followed by thorough rinsing. If the soldered joints are defective and contain holes the problem is magnified manifold.

### Copper Plating Printing Press Rolls

**Question:** We are plating high speed printing press rolls in regular acid copper solutions and experience some difficulty in a heavy build up on the ends of the cylinders. The rolls rotate in the plating solution at 48 rpm. We understand that such rolls can be plated without this build up and would appreciate any information you can furnish regarding such a procedure.

A. C. R.

**Answer:** The general problem of preventing treeing or excessive build-up in such an application is essentially one of balancing the current distribution over the entire length of the cylinder. Several methods of eliminating this problem are possible. The first method involves placing the copper anodes further away from the ends

of the cylinder so that the current flowing from the ends of the cylinder to these anodes is meeting the increased resistance of the greater path through the plating solution. The correct placement of the anodes can only be determined by trial and error methods. The second method involves using "thieves" in such a manner that they carry some of the current that would normally be carried by the cylinder ends. Here again trial and error is about the only way to establish correct procedure. In some cases it is also possible to increase the overall distance between all the anodes and the cylinder ends. This method is usually limited by the tank size.

Plating at lower current density will also lessen the problem, as will continuous filtration. Using the lower current density, of course, will increase the total amount of time required for a given plating thickness. Most of the baths which are used in decorative plating to provide smooth, bright deposits are unsuitable in printing roll work, as the copper deposit itself is usually too hard and not sufficiently ductile to permit proper engraving and repair work during the printing operations.

### Corroded Nickel Plating

**Question:** We are sending you a sample stainless steel shaft (Type 303) which has been nickel plated. As you can see, the shaft has discolored very badly after being used in a soft drink bottling plant. Can you tell us what is causing the discoloration? Perhaps our plating is at fault. If so we would appreciate a better formula for plating on stainless steel.

S. B. A.

**Answer:** Examination of the corroded shaft indicates that the nickel plating has been entirely dissolved off the surface and that the stainless shaft itself is heavily pitted. It is this finely pitted condition which is causing the discoloration. One end of the shaft, which apparently has not been exposed, shows that the nickel plating has

good adhesion, therefore it is felt that your plating procedure is not at fault. Special nickel formulations for plating on stainless steel usually accomplish only a better adhesion, which is not a factor in this problem.

It is believed that the corrosive environment under which the shaft is used is too severe for the nickel plating, and perhaps some other type of plating would better resist the environment involved. Tin plating would be a good one to try. Of course a much heavier nickel coating would probably give added service life to these shafts, but the fundamental problem would appear to be in obtaining a more resistant surface coating than nickel plating alone.

### Gold Plated Jewelry

**Question:** We use a potassium dichromate dip on our gold plated jewelry to prevent tarnishing and would like to know if this will have any effect on the skin of a person wearing said jewelry?

B. W. E.

**Answer:** Assuming that the potassium dichromate solution will be thoroughly rinsed from the gold plated jewelry there can be no effect on the skin of anyone wearing it. However, it is very doubtful whether the dichromate treatment is contributing anything towards preventing tarnishing.

### Electropolishing Silver

**Question:** I would like to install an electropolishing unit in our silver plating department and would appreciate any information or references you can send me.

F. J. B.

**Answer:** Details of a method for electropolishing silver were given in a recent article published in *Metal Finishing* (April 1949, page 55), tear sheets of which are being sent to you. The process described is patented and you can get complete details regarding licensing, etc., from the Arthur D. Little Co., 30 Memorial Drive, Cambridge, Mass.

### Gray Chrome Plating

**Question:** In chrome plating brass water hose nozzles we frequently encounter gray areas, which of course spoil the appearance of the final product. A sample is being sent for your

examination. The following cycle is used:

1. Clean and brush in alkali soak cleaner (2 oz. per gallon).
2. Anodic clean (8 oz. per gallon).
3. Rinse.
4. Dip in 20% muriatic acid.
5. Rinse.
6. Cathodic clean in sodium cyanide (6 to 8 oz. per gallon).
7. Rinse.
8. Sulfuric acid dip (10%).
9. Rinse.
10. Chrome plate for 3 minutes.
11. 4 water rinses.

S. H. E.

**Answer:** Examination of the sample part indicates that the brass nozzle has become etched, most likely in your excessive cleaning cycle. As this is a screw machine part having a fairly clean surface to begin with, it should not be necessary to do all the cleaning listed in your operations. A vapor degreasing operation or emulsion solvent cleaning should be sufficient to

remove any oil and grease, and a short dip in cyanide or brass bright dip followed by a rinse should be all that is required before chrome plating. The chrome on the areas that have not become etched seems to be in good condition, therefore it is felt that there isn't anything wrong with the actual plating step.

### Matching Stainless Steel Finishes

**Question:** We have to perform several bending operations on stainless steel sheet, which we purchase with a No. 4 finish. During the bending operation the finish is spoiled at the corners and we would appreciate information on how we can touch up these areas to match the rest of the parts.

F. T.

**Answer:** A number 4 stainless steel finish can be duplicated by using a number 120 grit and a grease stick on a fairly soft buff. The names of manufacturers of suitable grease stick are being sent to you.

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# PATENTS

## Composition to Blacken Surfaces of Copper and of Alloys Containing Copper

*U. S. Patent 2,481,854. J. D. McMajon, assignor to Enthone, Inc.*

A solid composition consisting essentially of a hydrated alkali metal hydroxide of the group consisting of sodium hydroxide and potassium hydroxide and a relatively smaller amount of an alkali metal chlorite of the group consisting of sodium chlorite and potassium chlorite, the chlorite being uniformly fixed in the water of hydration of the hydroxide.

## Protective Surface Treatment of Magnesium Base Alloys

*U. S. Patent 2,430,443. G. E. Coates, assignor to The Permanente Metals Corp.*

A process for the protective surface treatment of magnesium base alloy which comprises treating the alloy with a solution consisting of water, 0.2 to 0.5 mol per liter of dichromate ion of at least one compound of the group consisting of the dichromates of lithium, potassium, sodium, magnesium, and ammonium, 0.6 to 1.0 mole per liter of sulfate ion of at least one compound chosen from the group consisting of the sulfates of lithium, potassium, sodium, magnesium, and ammonium, a buffer mixture comprising acetic acid and sodium acetate and containing 0.2 to 1.0 mole per liter of acetate ion and adapted to maintain the pH of the solution at from 4.6 to 5.9, the said dichromate and sulfate compounds being so chosen as to yield an ammonium ion concentration of 0.4 to 3 moles per liter.

## Abrasive and Buffing Belt

*U. S. Patent 2,483,293. R. G. Mink and W. L. Ryman.*

An endless surfacing belt having an abrasive coating on one face thereof and provided throughout substantially its entire other face with fibers, the major number of which are cemented only at one end to the belt, the fibers being not greater than approximately one-quarter inch in length and for the most part normally extending in perpendicular relation to the plane of the belt.

## Rectifier Treatment

*U. S. Patent 2,483,110. G. W. Smith, assignor to P. R. Mallory & Co., Inc.*

The method of lowering the resistance of dry disc magnesium-copper sulphide rectifiers into which there is lacquer and paint seepage which comprises subjecting said rectifier to a high current treatment to remove such lacquer and paint.

## Apparatus for Measuring or Indicating Roughness or Undulations of a Surface

*U. S. Patent 2,483,668. R. E. Reason and D. R. Berridge, assignors to Taylor, Taylor and Hobson Limited*

A pick-up unit for use in apparatus for measuring or indicating the roughnesses or undulations of a surface, comprising a casing, means whereby the casing can be located in any chosen position relatively to the surface under investigation, a stylus for engaging with the surface, a pick-up head carrying the stylus, a traversing member carrying the pick-up head, link mechanism constituting an interconnection between the casing and the traversing member and comprising a group of mutually pivoted links constituting in effect two straight-line linkages respectively constraining two points of the said member to perform substantially straight-line movements in the same direction, and driving means cooperating with the link mechanism to cause the traversing member and the pick-up head to be traversed over the surface along the straight-line path determined by the link mechanism.

## Polishing Composition

*U. S. Patent 2,483,701. T. G. Hawley, Jr., B. J. Kummer and J. W. Barnes, Jr., assignors to The Diversey Corp.*

The method of making a wax composition which comprises mixing by weight of the composition, about 6.10% of a wax, about 4.05% of a rosin-maleic anhydride-glycerine resin containing from 72.8 to 86.0% by weight of rosin, 5.0 to 14.1% of maleic anhydride and 9.0 to 13.1% glycerine, and about 1.80% of oleic acid, heating and stirring to blend the mass into a homogenous mixture, adjusting the temperature to about 205-210° F., adding about 1.05% monoethanolamine, adding about 43% water at about 205-210° F., stirring while holding the tem-

perature at approximately 200° F. until the solids are completely emulsified, and adding about 44% water at room temperature and cooling the emulsion.

## Buffing Wheel

*U. S. Patent 2,483,879. G. R. Churchill*

A buffing wheel having radially extending buffing elements, said elements each comprising a core of a plurality of plies of material having radially extending edge portions, the said edge portions only of said core plies being impregnated with a buffing compound, and a sheath of unimpregnated material enclosing all but the end extremities of said core.

## Corrosion Inhibitor

*U. S. Patent 2,484,010. E. A. Bried, assignor to Hercules Powder Co.*

A liquid composition for depositing a corrosion inhibiting film upon metal surfaces consisting essentially of an unctuous solvent and from about 0.5 to about 5% by weight, based on the solvent, of a corrosion inhibiting salt of a dehydrogenated rosin amine and a saturated fatty acid having a molecular weight between about 170 and 350.

## Electrodeposition Apparatus

*U. S. Patent 2,484,068. J. M. Booe, assignor to P. R. Mallory & Co., Inc.*

In an apparatus for the electrodeposition of metal from a bath, the combination which comprises an anode in the form of a rod composed of the metal to be deposited, said rod having a body portion of substantially uniform cross section and an end portion tapered to a point, means for slidably supporting the body portion of said rod, a supporting plate for the point of said rod, and means for urging the point of said rod against said plate, said supporting means and plate being so constructed and arranged as to expose solely the tapered end portion of the rod to contact with the bath.

## Method of Bonding Aluminum to Steel

*U. S. Patent 2,484,118. R. S. Reynolds, assignor to Reynolds Metals Co.*

A method of continuously cladding steel strip with aluminum, which consists in feeding steel strip through an electrolytic iron plating bath and depositing relatively pure electrolytic iron thereon, continuing the movement

of the strip through drying and heating zones, wherein the strip is raised to a temperature of from 800° to 900° F., and bringing aluminum in web form into face association with the steel strip followed by the step of hot rolling under reduction pressure and below the fusing temperature of aluminum.

### Sand Blasting Machine

*U. S. Patent 2,483,956. W. J. Workman, assignor to Western Electric Co., Inc.*

In a sand blasting machine a unit including a nozzle, to direct an abrasive material such as sand in a given path, a vacuum chamber, an air inlet to the vacuum chamber, an abrasive inlet to the vacuum chamber spaced from the air inlet and an auxiliary air inlet to the vacuum chamber between the air inlet and the abrasive inlet, a hopper for a supply of the abrasive material, a conduit for the abrasive material connecting the hopper to the abrasive inlet of the unit, a supply line for air under pressure, an air line connecting the supply line to the air inlet of the unit, a normally closed valve interposed between the supply line and the air line actuatable to open communication between the lines whereby the air under pressure travelling through the unit and out of the nozzle will create a vacuum in the vacuum chamber to draw the abrasive material through the conduit from the hopper where it will be forced through the nozzle by the air under pressure, the quantity of abrasive material being withdrawn from the hopper depending upon the vacuum in the vacuum chamber, an auxiliary air line connected to the auxiliary air inlet, and a valve in the auxiliary air line actuatable to admit varied quantities of air at atmospheric pressure into the vacuum chamber between the air and abrasive inlets to vary the vacuum in the chamber to vary the amount of abrasive material drawn into the unit.

### Selenium Rectifier

*U. S. Patent 2,484,204. W. E. Blackburn, assignor to Westinghouse Electric Corp.*

The method of treating rectifiers comprising a layer of selenium sandwiched between layers of metal, which comprises immersing said rectifier in oil and impressing between said layers a direct-current voltage tending to cause current flow in the higher re-

sistance direction through said rectifier while still immersed in said oil.

### Lead Coating Process

*U. S. Patent 2,484,540. J. P. Whitehouse, assignor to Republic Steel Corp.*

The process of lead coating a metal article which comprises the steps of electrodepositing a coating of lead on such an article and closing pin holes in the coating and increasing the resistance of the article to corrosion by frictionally wiping said coating with soft, fibrous material while the coating is in a mineral oil.

### Process and Apparatus for Purifying Pickling Acid and Recovering Sulfates Therefrom

*U. S. Patent 2,484,799. N. Swindlin*

A process for purifying and reviving a solution of metal sulphates in sulphuric acid comprising causing said hot solution with precipitated metal sulphates to ascend a barometric column under high vacuum so as to overflow from the top thereof, evaporating vapors from said overflowing solution under vacuum and absorbing said vapors with sulphuric acid to cool said overflowing solution, collecting said overflowing solution and separating the precipitated metal sulphates therefrom, and causing said overflowing solution from which the precipitated metal sulphates have been separated to flow around said column in a direction counter to the unseparated solution ascending therein to cool said unseparated solution.

### Bright Nickel Plating Compositions and Process

*U. S. Patent 2,485,149. M. L. Freed, and O. A. Stocker, assignors to The Seymour Mfg. Co.*

A nickel electroplating bath addition agent composition comprising a nickel electrodeposit brightening agent consisting essentially of (I) a sulfonated aryl aldehyde and (II) a sulfuric acid reaction product of an alkyl-substituted-mercapto-dihydropyrimidine, said reaction product resulting from reacting an alkyl-substituted 2-mercapto dihydropyrimidine with concentrated sulfuric acid with accompanying evolution of sulfur dioxide from the reaction mixture which is heated until such evolution has substantially ceased, and having the aldehyde (I) and the reaction product

(II) in the ratio of from about 0.5 to about 3.0 parts of the aldehyde (I) to from about 0.005 to about 0.02 part of the product (II), said addition agent composition being capable, upon addition to an aqueous, acid nickel plating bath comprising in solution in its aqueous medium a nickel ion-yielding material consisting essentially of a mixture of nickel sulfate and nickel chloride, of causing a bright, ductile cathodic deposit of nickel to be obtained upon passing an electric current from the anode through said bath to the cathode when the sulfonated aldehyde and the sulfuric acid reaction product of the substituted-mercapto-pyrimidine are present in the bath respectively in combined, cooperative quantities sufficient to permit the bright, ductile deposit of nickel to be obtained under the operating conditions.

### Abrasive Lubricant Supply Device

*U. S. Patent 2,486,322. B. F. Paul and R. R. Wilkinson, assignors to Metal Coatings & Mfg. Co., Inc.*

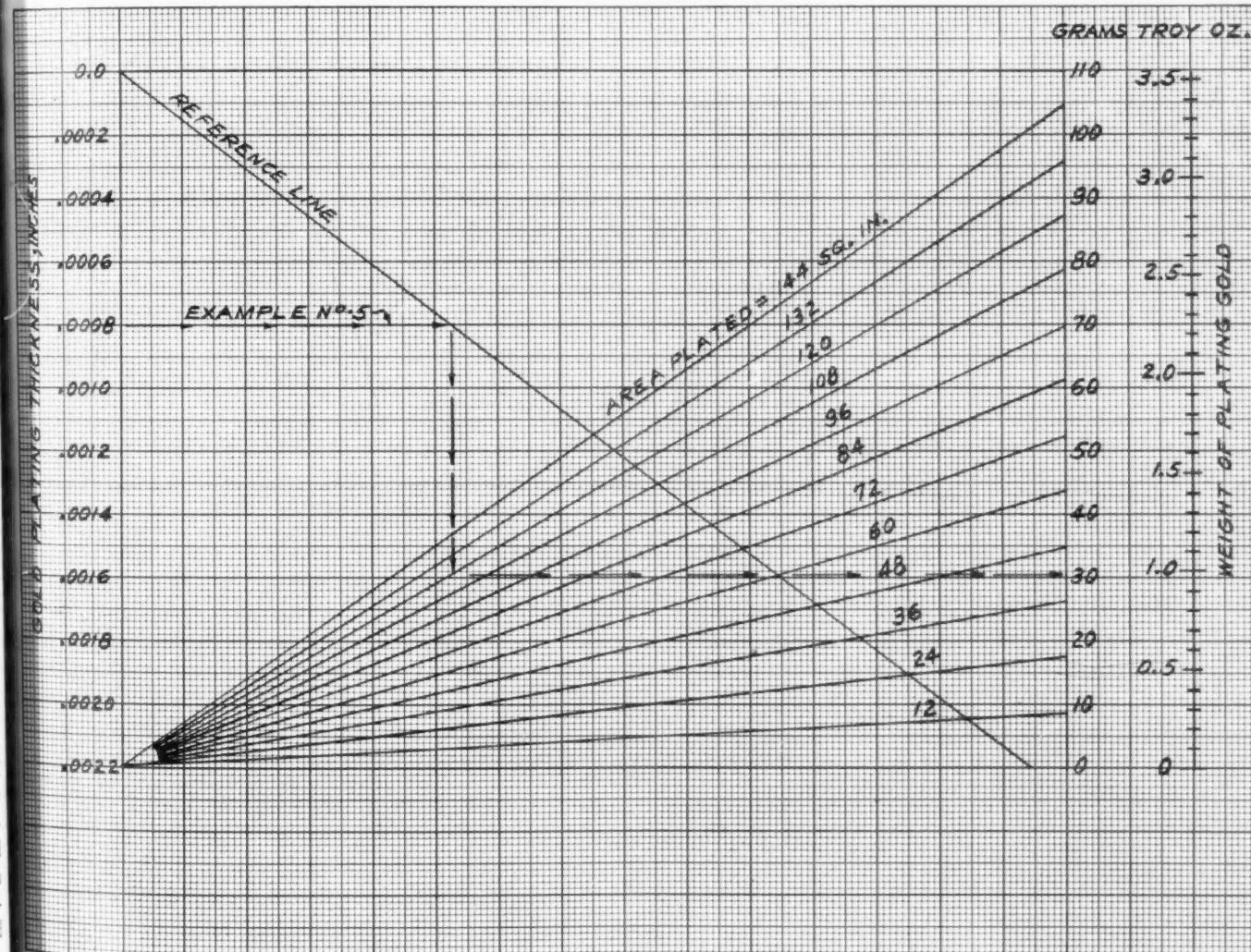
In a polishing and like machine having a substantially horizontally disposed rotatable shaft and a polishing and like wheel thereon, the combination therewith of a relatively large area bowl rotatable upon a substantially vertical axis, means for rotating the bowl at a rate at least sufficient for centrifugal force to be effective, the bowl side in radial section being directed upwardly and at its upper portion being directed inwardly, the bowl being disposed below said wheel, and the shaft projecting across the bowl upper portion at one side, a conduit open at both ends and supported so that its lower open end is disposed immediately adjacent the bowl interior and directed in opposition to the direction of bowl rotation and at a distance sufficiently remote from the bowl axis to cause an abrasive lubricant to enter the conduit and pass the highest elevation thereof, the other open end of the conduit discharging immediately contiguous to the wheel and in the direction of wheel rotation, the intake end of the conduit being disposed at an elevation below the level of the lubricant in the bowl when it is at rest and above the bottom of the bowl, and a scraping deflector for deflecting inwardly liquid adjacent the bowl side and scraping therefrom solids thereon and adhering to that side.

## Calculating Metal Cost in Gold Plating

With the aid of the chart below it is a simple matter to calculate the metal cost for depositing a given thickness of gold on a known surface area. The example shown by the dotted line illustrates the calculation for a deposit of .0008" of gold on a surface of 120 sq. inches. Weight of gold is given in Troy ounces. The chart below is for heavy or industrial gold deposits. For thinner decorative deposits the appropriate fractional conversion can be made. The weight of gold metal can be converted to the equivalent weight of gold salts by multiplying by the following factors:

Gold to Gold Potassium Cyanide (crystals) = 1.645

Gold to Gold Sodium Cyanide = 1.38



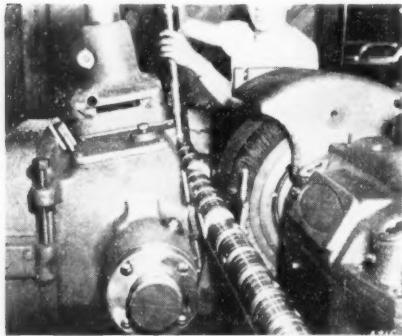
# Recent Developments

New Methods, Materials and Equipment  
for the Metal Finishing Industries

## Centerless Brushing of Cylindrical Parts

*Osborn Mfg. Co., Dept. MF, 5401 Hamilton Ave., Cleveland 14, O.*

A recent development of using a rotary brush on a conventional centerless grinder has been developed by the research staff of this firm. By using an Osborn 20-inch diameter Master Spiral Brush on a centerless grinder, one manufacturer of pistons is saving considerable time on assembly, it is



claimed. The three-inch diameter pistons now assemble easily with increased precision, and in addition, centerless brushing has prolonged the smooth working life of this part, according to the firm.

The brush being used has a six-inch face and is made from .005" diameter crimped wire. The pistons are now machined, ground and then "centerless brushed" for finish. The work is gravity fed from a magazine type chute. Centerless brushing can be widely applied on any round work with little expense, it is claimed, as a practical, low cost means of finishing pins, studs, bushings and other similarly shaped parts. A large range of brush sizes, wire, Tampico, or synthetic, can be used depending on the type of work, material and finish desired.

## Plating Rectifiers

*Electric Products Co., Dept. MF, 1725 Clarkstone Rd., Cleveland 12, O.*

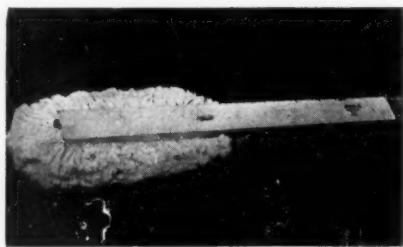
This firm has recently announced a

new line of selenium rectifiers for all types of electroplating and electro-forming applications. Widely known as suppliers of high quality motor-generator equipment, this firm can now furnish a complete line of rectifiers in all sizes featuring high efficiency selenium stacks made by the *Federal Telephone and Radio Corp.* Several new features incorporated in their rectifiers are claimed to give the E-P line longer life, greater efficiency, greater flexibility, and lower maintenance costs. Further details may be obtained by writing to the above address.

## Cotton Potash Brushes

*Hanson-Van Winkle-Munning Co., Dept. MF, Matawan, N. J.*

A new and improved design in cotton potash brushes has been developed by the above firm. The outstanding feature of this brush is that the cotton wicking is anchored by a twisted stainless steel base wire. Originally this new and superior construction was available only in a straight handle brush (known as No. 9819-A); Now it has been applied to a curved handle brush designated as No. 9860-A.



The additional merits of this new brush are claimed to be:

1. 20% more cotton than standard.
2. Generous amount of cotton wicking around end of block, just where it is needed the most.
3. Neatly trimmed.
4. Stainless Steel wire not attacked by solutions commonly used.
5. Lower cost.

## New Polishing Lathe Features Large Overhang

*Vonnegut Moulder Corp., Dept. MF, 1819 Madison Ave., Indianapolis 25, Ind.*

A new buffing and polishing machine has been developed by The Vonnegut Moulder Corporation, Indianapolis, Indiana, makers of the Maschke line of grinding and buffing ma-



chines and the Vonnegut Polishing Head.

The novelty of this design is in the so-called "underslung spindle". This design, the company claims, has a number of important advantages:

1. Unusual rigidity of a relatively long, thin spindle is provided because the bearing support is entirely above the spindle. With this construction neither depth or width of the overall need be restricted. It may be as massive as required to obtain proper support for the end bearings and these bearings may be located immediately adjacent to the wheel flanges with minimum spindle overhang.

2. There are no structural interferences for spacing other bearings best advantage along the underside of the bearing support or for locating the motor and power transmitting details.

3. The design and method of manufacturing the frame provides maximum dependability of accuracy.

bearing alignment as well as strength and rigidity.

4. Longer and larger bearing support arm can be furnished for longer spindles to meet special requirements without excessive additional cost.

5. The novel design provides complete freedom of operating action by eliminating all interferences under the spindle between the wheels and side walls of the base.

This new Marschke Buffing Machine is made with one and two spindles in various sizes with motors ranging from 1 HP to 30 HP.

#### Chemical Resistant Cement

The Electro Chemical Supply & Engineering Co., Dept. MF, 750 Broad St., Emmaus, Pa.

This firm announces a new thermosetting synthetic resin cement, Lecite, having novel physical and chemical properties. Lecite is said to be inert to solvents, fats, oils, greases, alkalis and acids, except strong chromic, nitric, and sulphuric over 60°Bé. at temperatures to 375°F. Lecite is useful for jointing acid-proof brick and pipe in the construction of neutralizers, disposal units, tanks, process equipment, towers, fume ducts and stacks, floors, etc., where the above corruptions are a factor. It may be stored indefinitely at atmospheric temperatures, is non-toxic, will not foam to form a porous mortar and give off toxic fumes, sets quickly to form a dense, shiny, shock resistant joint, it is claimed. It is non-inflammable, and has a compression strength in excess of 10,000 pounds per square inch.

#### Black Oxide Coating

Heatbath Corporation, Dept. MF, Springfield, Mass.

The new Controlled Oxidation Penetrant represents the latest development in a black oxide process and product. The operation of this new Controlled Oxidation Penetrant is claimed to be very simple.

All of the present available products are either a fused or granular mixture consisting of all ingredients in one package. Heatbath has developed a two component product. One package contains a granular mixture labeled Penetrant SS, which is used in making up the original bath and also serves to replenish dragout losses. The second package contains compressed

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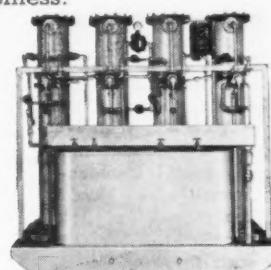
The labor, down time, and the inconveniences of cleaning, replacing the filter media, and reassembling the filter for every new filter cycle—all are eliminated by the Industrial Air-Wash Cleaning Method available for all models. It is necessary to remove the cover only when new filter cloths are installed. With Industrial filters, a clarified plating solution is always assured.

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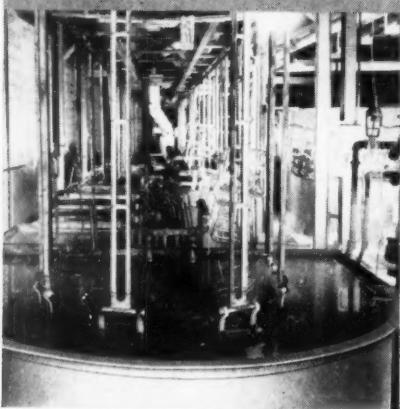
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briquettes called Penstrate Brix. Penstrate Brix are a new and more effective combination of oxidizers, activators and inhibitors. Brix are used in very small amounts to maintain a constant bath strength.

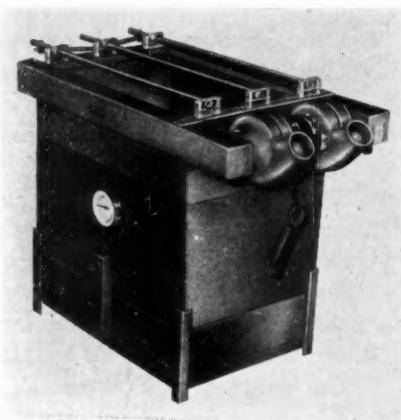
The bath operates between 265° F and 315° F. Deep jet black colors are imparted to steel very rapidly and the process can be operated in single or double baths, it is claimed. The cost of operation is said to be very low in comparison with present practices.

Many of the objectionable red and brown smuts often encountered can be eliminated, due to the inhibitors and activators in the briquettes, according to the firm.

### Small Scale Plating Units

*Hollywood Bronze Supply, Dept. MF, 1766 N. Vermont Ave., Hollywood, Calif.*

Recently announced by this firm is a line of plating units for plating such



objects as baby shoes and other small items. Among these new items are a stainless steel plating tank equipped with thermostatic temperature controls, heaters, and large dial thermometer, in various sizes up to 20 gallons capacity. Another item is a lead-lined tank for chrome plating equipped with exhaust and thermostatic heating and controls. This chrome tank comes in 16, 24, 48 gallon sizes. Another item added to their line is a reverse current power supply in 50 and 100 ampere sizes. The firm can also supply complete cycle set-ups for all types of plating, including cleaning and rinse tanks, heated and temperature controlled. Rubber lined small tanks are also available, with moving cathode bars, as well as small wax-dipping tanks for masking operations. Photo herewith illustrates one of their elec-

trically heated, thermostatically controlled plating tanks, equipped with exhaust fans.

### Demineralizing Equipment

*Illinois Water Treatment Co., Dept. MF, Rockford, Ill.*

Development of mixed bed (cation-anion) demineralizing equipment is announced by the above firm. According to company officials, the Ilco-Way mixed bed unit produces a chemically pure water containing less than one part per million total solids, having a pH of 7 and resistances of over 10 million ohms per cubic centimeter. Other advantages claimed for the Ilco-Way mixed bed unit are that it requires less regeneration time, less installation space and a lower initial investment than standard two or four bed demineralizers. Additional information is available on request.

### Lightweight Sand Blast Helmet

*Willson Products, Inc., Dept. MF, Reading, Pa.*

A new lightweight helmet for protection against heavy concentrations of dust and abrasives in sand blasting operations has been developed by this firm. Outstanding feature of the helmet is its extremely light weight. Weighing only six pounds, the helmet has been designed for maximum comfort over long periods of wear. Additional features are:

1. *Elimination of separate face mask.* Air is supplied to the wearer through a perforated tube at the top of the helmet, thus doing away with the need for a separate face mask.
2. *Adjustable headsize and dustproof hood.* The latex-covered canvas hood is supported by a headgear containing a removable soft felt skull cap, laced for adjustment to any head size. A flannel collar, zippered inside the hood and drawn together around the neck makes the hood dustproof.
3. *Non-fogging lens.* Metal supports keep the front of the helmet away from the face to allow the air stream to ventilate properly and insure non-fogging of the lens.

The equipment has the Bureau of Mines Approval No. 1923 for respiratory protection during abrasive blasting in any atmosphere not immediately



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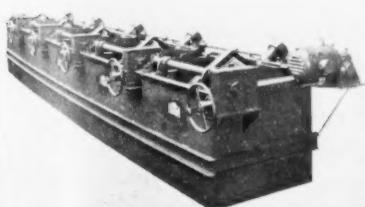
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harmful or from which the wearer can escape without the aid of the respirator. The air supply to the equipment is accurately controlled by means of a break-valve coupling, which automatically closes the compressed air line when uncoupled.

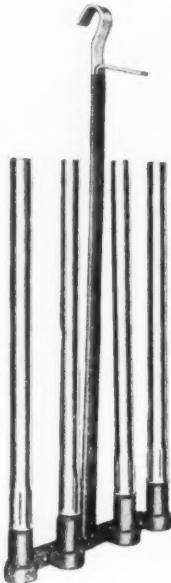
### High-Capacity Barrel Plating Machine

Daniels Plating Barrel and Supply Co., Dept. MF, 129 Oliver St., Newark 5, N. J.

This firm introduces a five-cylinder plating barrel unit having a common steel tank. Heretofore, the largest Daniels Plating Barrel with a common tank consisted of two cylinders; however, a newly-designed ratio lift affords an infinite number of cylinders in a common tank of double-welded steel construction, with or without rubber lining, as pictured here. The cylinders in this type machine may be constructed of their standard heavy reinforced Bakelite, moulded hard rubber, or HT lucite.

The popular Daniels contact design, that has proven successful in thousands of production jobs, is employed here to great advantage. As a result of this contact design, many parts may be plated at high-current densities and

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Now an improved Plastisol rack insulation makes for still better insulation results with consequent lowered costs all along the line. Less time, and labor and cost to insulate all types of racks for electro plating; etching; anodizing and electroforming.

BUNATOL No. 1002 is the new improved Paste insulation that completely insulates in a single dip. This heat cured Plastisol is 100% solids consisting of high molecular weight vinyl resins dispersed in selected plasticizers. NOW more toughness and firmness; high gloss for free rinsing and to stop carry over; greatly improved adhesion and

made so it is easy to handle in the dipping tank. Of course the chemical resistance is unsurpassed.

Adhesion is important. With the new BUNATOL Primer No. X120 a single coat of baked-on primer gives to the thick Plastisol that secure adhesion that holds in all plating solutions. This means less cost as a single primer coat requires less labor and time.

We want you to know about No. 1002 rack insulation. Send us a rack and we will insulate it with No. 1002 without charge. Run this rack and you will have an actual shop test to prove how good this new insulation is. No matter what insulation you are now using, investigate this improved material.

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therefore improves plating time and throwing capacity.

These machines can be fitted with two flanged overflows for maintaining solution levels and with flanged fittings for constant filtering lines.

The advantages claimed for this type machine include: Extremely high production, simplified filtration of solutions, great ease in handling work, efficient plating, and reduced maintenance with single motor drive, etc.

### Non-Drying Rustproof Coating

International Rustproof Corp., Dept. MF, 12509 Plover Ave., Cleveland 7, O.

The above firm announces the use of a new "homogenizing" process for

their non-drying rustproofing product, Ircolene No. 19. Homogenizing of Ircolene No. 19 now provides an extra tight adherent film over steel and other metals to prevent oxidation, it is claimed.

Humidity and salt spray tests on the improved product, with 95% relative humidity at 95°, show a minimum film life of 5000 hours, according to the firm. On salt spray tests, (20% NaCl at 95°), minimum is 150 hours. On both tests a coating of zinc phosphate under Ircolene No. 19 more than doubled film life, it is claimed.

Ircolene No. 19 has been used by industry to protect non-ferrous metals from staining, tarnishing and to maintain top condition while in storage. Although similar to oil preparation,

Ircolene No. 19 is said to be more effective and its transparent coating does not detract from the original coating underneath, such as polished steel, etc. Ircolene No. 19 is of a low viscosity, consequently it provides great coverage.

### Polishing Wheel Cement

The Nevel Co., Dept. MF, 6432 Cass Ave., Detroit 2, Mich.

This firm announces their Detroit polishing wheel cement for use with all types of abrasives on all types of metals. The cement comes ready for use. The firm claims that their product is able to resist the high temperatures involved in heavy duty grinding and polishing operations, thus giving long life and lower finishing costs. The material is also claimed to be excellent for use in recoating belts.

### Filter Frames Now Made of Plastic Materials

Hercules Filter Corp., Dept. MF, Paterson, N. J.

Filter frames that can withstand the chemicals in many filterable materials and that can be handled safely in cleaning, are a factor in the cost of filtration.

The best filter frames in these respects have been made from stainless



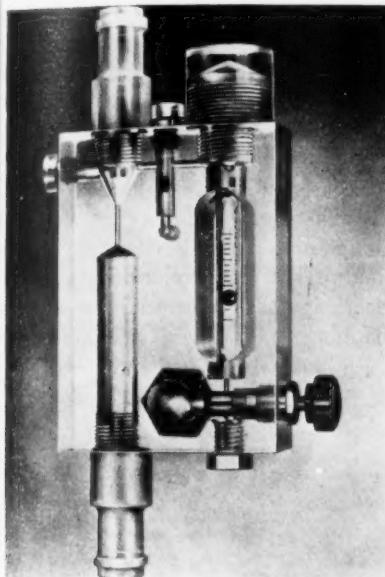
steel, which is costly, or of hard rubber that breaks down from high pressures or high temperatures, or in handling.

A new filter frame is announced made from a special plastic, that is resistant to both acids and alkalis even at higher temperatures. This frame is tough and not breakable in handling frequent fault of hard rubber frames.

## New Compact Chemical Feeder

Fischer & Porter Co., Dept. MF,  
Harrisburg, Pa.

A new compact, self-contained chemical feeder is now available from the above firm. Of transparent acrylic



plastic (measuring about 10" by 5" by 2" overall) this unit simultaneously controls, meters and dispenses relatively small amounts of bactericides, catalysts, disinfectants, fungicides, inhibitors, reagents and other chemicals into a larger stream. The built-in educator takes the place of a pump, and many highly corrosive chemicals can therefore be fed directly from a container.

The unit will treat up to 7000 gallons per day of water directly. In a bypass arrangement, using a solution containing .5% active reagent by weight, 5 parts per million of the reagent can be delivered to over 14,000,000 gallons of water per day.

## Diamond Refacer for Taber

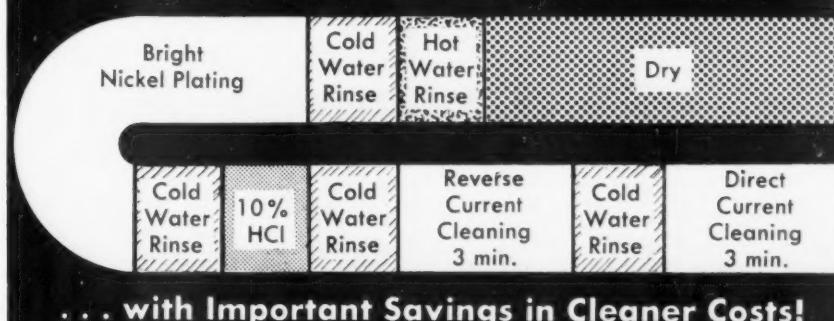
### Abraser Wheels

Taber Instrument Corp., Dept. MF,  
111 MEF Goundry St., North Tonawanda, N. Y.

The new Taber Diamond Refacer has just been announced for trueing small abrasive wheels ranging in size from  $1\frac{3}{4}$ " to  $2\frac{1}{4}$ " in diameter, such as the Calibrase and Calibrate Wheels used on the Taber Abrasive Wear Tester. The Taber "Abraser" is used for determining resistance to wear and abrasion of a wide range of textiles, plastic, painted, and electroplated surfaces.

Heretofore the wheels were refaced by running them against an abrasive

## How to Reduce Rejects to New Low in Bright Nickel Plating on Steel



### A TYPICAL CASE HISTORY:

Parts: Elements for Loose-Leaf Books.

Application of Cleaners: Direct and Reverse Current Cleaning.

#### FORMER CLEANERS

Tank Charge	16 oz. per gal.
Make-up	30# per day
Tanks Dumped	Every 2 wks.
Cost per lb.	8¢
Cost per day	\$7.00
Rejects	60%

Data from Product Application M202.7-49 11/25/49.

#### MAGNUS CLEANERS

Tank Charge	15 oz. per gal.
Make-up	12½# per day
Tanks Dumped	Every 6 wks.
Cost per lb.	15¢
Cost per day	\$2.90
Rejects	3%

Lower costs . . . no caustic fumes . . . better plating.  
Ask us for recommendations on YOUR cleaning jobs.

MAGNUS CHEMICAL CO. • 11 South Ave., Garwood, N. J.  
In Canada — Magnus Chemicals, Ltd., 4040 Rue Masson, Montreal 36, Que. Service representatives in principal cities.



disc under a load of 1,000 grams; however, this resulted in their becoming out of round. The new diamond wheel refacer provides the technician with a convenient means with which to dress the wheels perfectly true and restore them to perfect condition within a few minutes' time.



Its operation is simple, necessitating only the raising of the hood and clamping the wheels on the mandrel connected to the vacuum unit of the Abraser, lowering the hood and moving the diamond back and forth across the face by turning the handle attached to the lead screw.

The wheel refacer is driven by a precision 115 volt, 50/60 cycle totally enclosed motor, with diamond bored bearings, and the base is equipped with connection to the powerful suction unit furnished with the Abraser to carry off the abrasive particles.

Particular attention has been given to the enclosure of the slide holding the diamond so that Abraser particles will not clog the slide. A long pointed

# for { Real Buffing... Mirror Finish... Easier Cleaning....



## SPEEDIE Stainless Steel and Chrome Compositions Do the Job Every Time!

And they do the job RIGHT! You can't beat the best—and you get the best when you use SPEEDIE Stainless Steel and Chrome Compositions!

Have you an unusually tough buffing operation on a nasty piece of steel? Try SPEEDIE No. 471. It cuts and colors in one operation.

Job-proved through the years, SPEEDIE Chrome Compositions are

unmatched for removing burnt chrome or producing a fine mirror finish. All SPEEDIE Stainless Steel and Chrome Compositions are 100% saponifiable. The work is easy to clean so you save time and labor.

You'll also get perfect results with other SPEEDIE Compositions—Tri-polish, Nickel Finish, Satin Finish, Emery Cake and Grease Stick. Write for illustrated catalog today!

### Polishing Room Supplies and Equipment



**THE BUCKEYE PRODUCTS CO.**  
7033 Vine Street Cincinnati 16, Ohio  
Cable address: Buckprod

diamond is used in the head of a point of the knurled headed screw that can be moved in and out to take just the right amount off the outside diameter of the wheel and to accommodate different sizes of wheels. The diamond tool is readily changed at low cost when worn.

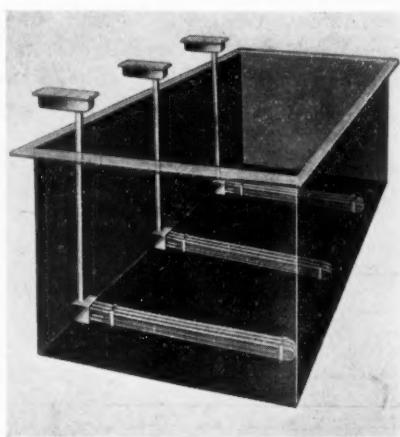
### Portable Tank Immersion Heater

*Edwin L. Wiegand Co., Dept. MF,  
7500 Thomas Blvd., Pittsburgh 8, Pa.*

A new portable tank immersion heater for heating oil, water solutions, solvent cleaners, and other similar compounds has just been announced by the above firm.

These heaters are rated from 2 to 18 kilowatts, 115 or 550 volts, single or 3-phase. Copper, steel, Inconel, or

stainless steel sheath is available, depending upon the corrosive properties of the solution to be heated. The heating elements at the bottom of the ver-



tical riser range in length from 12½ to 53 inches in straight sections. They may also be supplied in a circular shape to accommodate usage in round tanks with a minimum opening of 10½ inches. The riser can be fabricated in varying lengths to suit any tank depth.

The heated section can be had with either two or three hairpin elements. Two-element heaters are designed for a uniform dissipation of heat over the length of the tank. Three-element heaters afford a high concentration of heat in confined areas.

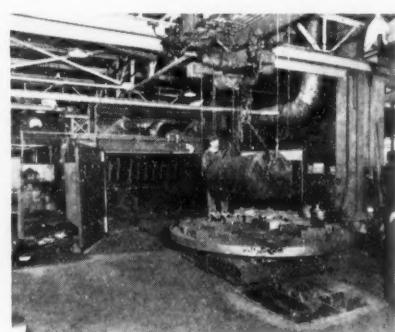
A gasketed, liquid-tight terminal box, with heat- and acid-resistant coating is mounted atop the riser for user's rigid-conduit line connections. It also protects against moisture, vapor, and drippings.

Sludge legs are available for installation by user, to prevent over-heating where sludge may accumulate on the bottom of the tank.

### Airless Blast Room

*Pangborn Corp., Dept. MF, Hagerstown, Md.*

This firm announces a new addition to its well known line of blast cleaning



and dust control equipment, the new Rotoblast Room, which provides airless, centrifugal-type blast cleaning for large castings, forgings or fabrications where size requires cleaning in room-type structures. Rubber-lined steel blast rooms, available in varying sizes, are served by two standard Rotoblast units and an Abrasive Separator which cleans the metal abrasive and returns it to the Rotoblast units for reuse. A power-driven blast room car is provided to facilitate loading and unloading of large castings; it enters the blast room on its own track through wide (12' 6") doors and is equipped with a revolving work table ten feet in diameter which is turned mechanically by means of contact with a friction wheel and revolves (at adjustable speeds of

4.3 to 13 RPM's) to expose all sides of the castings to the impact of the blast stream.

## Business Items

### Stevens and Udylite to Merge

An agreement contemplating the merger of *Frederic B. Stevens, Inc.*, into *The Udylite Corporation* has been announced by the officers of the two companies.

The necessary formal agreements are in course of preparation and will be submitted to the respective boards of directors and stockholders of the companies in due course. It is expected that the matter will be submitted to the Udylite stockholders at its annual meeting to be held April 27th of this year.

*Frederic B. Stevens, Inc.*, was founded upwards of sixty-five years ago and for a great many years has been a leading producer of foundry supplies, polishing compounds, and various related products. It operates plants in Detroit, Michigan; New Haven, Connecticut, and Buffalo, New York, and through wholly-owned subsidiaries operates plants in Windsor, Ontario and Springfield, Ohio. *Frederic B. Stevens, Inc.*, has offices and warehouses in principal cities and will continue its operations as a division of The Udylite Corporation.

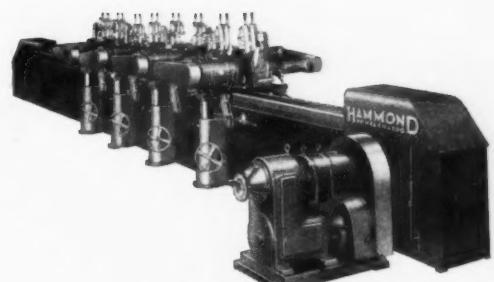
The Udylite Corporation is one of the leading manufacturers of plating machinery, supplies and equipment, and operates as well extensively in the production of automotive parts.

While the stock of The Udylite Corporation is listed on the New York Stock Exchange, the Stevens shares have been closely held.

### Magnus Acquires American K. A. T. Corp.

*The Magnus Chemical Company, Inc.*, of Garwood, New Jersey, has acquired full control of the American K.A.T. Corp., effective as of January 3rd, 1950, in conformity with understandings reached between the original stockholders of the American K.A.T. Corp. and officers of the Magnus Chemical Company. All functions of the American K.A.T. Corp. will continue, with the manufacture of "K.A.T." and the main office of the American K.A.T. Corp. henceforth located at Garwood, N.J.

The American K.A.T. Corp. was



# FASTER FINISHING

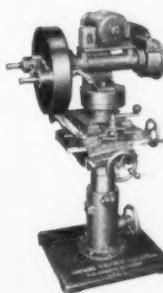
WITH

*Hammond*

STRAIT-LINE  
AUTOMATICS

ROTARY AUTOMATICS

JUNIOR  
AUTOMATICS



There are ten new Junior Automatics in the Hammond Line, to be used with polishing or buffing wheels or with abrasive belts. Model E2PF shown.

Users of Hammond Automatics report 2000 pieces or more per hour, more uniform, better finishing, less operator fatigue and specially, lower costs.

SEND SAMPLES: Send us one finished and several rough samples. You will receive a complete Engineering Report and Production Analysis without obligation.

*Hammond*  
OF KALAMAZOO

Good Machinery Since '82

*Hammond Machinery Builders*  
INC.

1601 DOUGLAS AVENUE ★ KALAMAZOO, MICHIGAN, U. S. A.

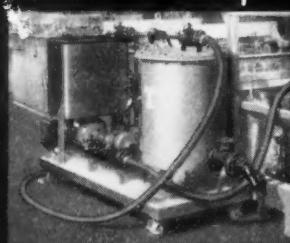


J. D. Holmes

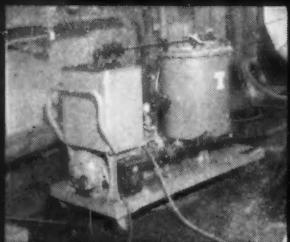
formed in 1938 and since then has engaged in the manufacture and sale of K.A.T. All-Colloidal Water Treatment. The corporation's activities extend from coast to coast and into many foreign countries. The officers of the corporation and those of the Magnus Chemical Co. saw many advantages in combining the activities of the American K.A.T. Corp. with those of the Marine and Power Plant Service Division of Magnus. This led to the developments as above stated.

Mr. J. D. Holmes, in addition to continuing as general manager of the Marine and Power Plant Service Division of Magnus Chemical Co., has been elected to the office of president of the American K.A.T. Corp. Mr. Holmes

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Titeflex  
FILTER  
for every  
PLATING JOB**



Plating aircraft parts



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Titeflex Filters are high in efficiency . . . low in cost. They require no replacement parts such as bags, sheets, etc. They are cleaned by an efficient backwash system, entirely eliminating waste labor. And they produce the highest possible degree of filtration. Plating shops throughout the country are finding Titeflex Filters the correct answer to their filtering problems.

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The filter with the backwash

**TITEFLEX, INC.**

500 Frelinghuysen Ave., Newark 5, N. J.

succeeds Mr. Michael Stone, who has been president of American K.A.T. Corp. The new board of directors offered him the opportunity to continue with K.A.T. in his capacity as president, but he has chosen for personal reasons to pursue other plans in the future, feeling that the new officers of the corporation are qualified in all re-

spects to carry on and expand the activities of the American K.A.T. Corp.

It is confidently anticipated by all concerned that the above developments will benefit all of the representatives and agents who sell, service and distribute "K.A.T.," and as a result will be to the best interests of the clients of the American K.A.T. Corp.

**New Research Lab for Cowles Chemical Co.**



Cowles Chemical Co., Cleveland, O., has moved its research and development laboratory from the campus of Syracuse University to greatly enlarged quarters at 105 South Townsend St., in downtown Syracuse, N. Y., according to announcement made by C. W. MacMullen, Technical Director of the Company.

The new laboratory is of fire-proof construction, having a reinforced concrete floor, brick walls, and sheetrock ceiling. Main aisles run lengthwise down each outside wall of the building with metal work tables placed perpendicular to them, so that there is complete access on all sides. The laboratory is located on the second floor of the building, and safety is further provided by a ramp leading to the ground floor at one end, two exits at the other end and a full stair-type fire escape at one side of the building. Safety showers have been installed, and portable carbon dioxide fire extinguishers located on all walls.

The laboratory benches consist of double tables, 16 feet long, with sinks

at one end of each. Hoods of the baffle type, six feet long, in pairs, butt up against the opposite end of the double work tables. The surfaces are of soapstone. Adequate services consisting of hot and cold water, gas, compressed air, 110 and 220-volt AC current are supplied to all work benches. The services are carried to sources above the ceiling, so that these lines are almost entirely concealed. Fluorescent lights are used over the benches. Special equipment located along the outside walls includes glass blowing table, low distillation bench, large oven, automatic electric water still, chipped ice storage chest, and drafting table.

Research projects at Syracuse include development of heavy chemicals in the silicate field, laundry products, metal cleaners, detergents and bactericides for the food processing industries, organic research and the engineering of new processes and equipment for the company's three plants located at Lockport and Skaneateles Falls, New York and at Sewaren, New Jersey. These projects are conducted

by a staff of twenty chemists and engineers under the direction of Dr. MacMullen.

#### Pennsalt Names Cleveland Lane Manager of Public Relations

Formation of a Public Relations Div. of the Pennsylvania Salt Mfg. Co., with *Cleveland Lane* as manager, was announced by *George B. Beitzel*, president.

Mr. Lane, who previously served as Pennsalt account executive with Geare-Marston's Public Relations Dept., came to Pennsalt from the Home Life Insurance Company in New York where he was manager of the Field Service Division. Before his four years of war service with the Army, Mr. Lane was associated with the Brush-Moore Newspapers in Ohio.

#### MacDermid Takes Over Cleaner Business of Ferro Enamel

The *Ferro Enamel Corp.*, *Cleveland, O.*, has recently announced the transfer of the manufacturing and distributing rights of their complete line of Ferro Cleaning Compounds to *MacDermid Incorporated, Waterbury, Conn.* In making the announcement, *Mr. Glenn Hutt*, Assistant to the Presi-

dent of Ferro Enamel, advised that Ferro's decision to transfer the cleaning portion of their business to MacDermid was prompted by their desire to concentrate on newer aspects in the porcelain enameling field, at the same time turning over the sales and service phases of the metal conditioning to MacDermid engineers, whose 28 years of experience qualify them as one of the leaders in service and supply in the metal finishing field.

Ferro metal cleaning compounds will be manufactured by MacDermid at their plants in Cleveland, Chicago and Waterbury, with warehouse stocks also available in New York, Detroit and St. Louis. Technical representatives and service men are located in these and other industrial areas. The sale of Ferro metal cleaners will be through regular MacDermid distributors in the Midwest and Southern States, and through MacDermid representatives in the Eastern States. However, Ferro Enamel will resell these cleaners exclusively to the porcelain enameling field. The West Coast is in no way affected by this new arrangement as it will continue to be serviced by the Ferro Enamel Corp. of Los Angeles, California.

#### Macbeth Corp. Moves to New Quarters



The *Macbeth Corp.* announces that since January 2, 1950, it has been occupying its new plant at Newburgh, New York. From that date on all manufacturing activities of the Macbeth Corporation, together with its executive and general offices, were located at Newburgh, which is situated on the

west bank of the Hudson River, about sixty miles north of New York City and served by railroad and highway.

Greatly increased area in this modern plant will permit an expansion of Macbeth manufacturing and research facilities and allow improved service to its many customers.

Check these  
OUTSTANDING  
FEATURES  
of the new

## Luster-on®

UTILITY 15

ZINC BRIGHT DIP

- ✓ Dilute up to 10 times
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- ✓ Rack or bulk work
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# Start Clean . . . Stay Clean!



**Use Red Label Darco S-51 in your plating bath regularly to get better work at lower cost!**

Don't put clean work into a plating bath of questionable purity! Don't risk wasting the time, labor, and expense that goes into cleaning work for plating.

*Start clean . . . stay clean!* Darco adsorbs impurities to its surfaces before they can be deposited on the freshly cleaned surface of your work.

Darco Red Label S-51 is especially easy to handle . . . to wet . . . to incorporate into a slurry. It's especially treated for use in plating—*the only carbon that will meet the benzol-mercury test!* Place an order for Red Label Darco S-51 today. Practically all leading suppliers carry Darco—*do not accept substitutes!*



**DARCO  
CORPORATION**  
60 East 42nd Street, New York 17, N. Y.

## Thank You

We wish to thank the following friends who so kindly sent Christmas cards and greetings during the holiday season, and to wish them in return a most happy and prosperous New Year:

Allbright Associates.  
Allis, Lewis Co.  
American Nickeloid Co.  
American Society for Metals (Walter Morrison)  
American Wheelabrator & Equipment Corp.  
Baker, M. E. Co. (Arthur W. Collins).  
Beresford, L. G.  
Binai, Walter.  
Blake, Dudley.  
Boggess, T. R.

Bregman, Adolph.  
"Car Load Andy".  
Cooper Alloy Foundry Co.  
Divine Brothers Co. (B. D. Divine).  
Dow Chemical Co.  
DuMond, T. C.  
Faint, Edward W. T.  
Fotheringham, W. M.  
Grupp, George W.  
Haas, Joseph.  
Hague, Louis M.  
Hogaboam, George B.  
Imperial Knife Co., Inc.  
Jeydel, Alan K.  
Kellner, Henry L.  
Koble Tank Mfg. Co. (Frank Koble).  
Kushner, Joseph B.  
Leather, Robert.  
Levine, Henry, & Son, Inc.

MacDermid, Doug.  
Malool, Jack.  
Marc Air Conditioning & Refrigeration Corp.  
Mathewson, W. A.  
McKnight, Floyd.  
Melnitsky, Ben.  
Miller Electric Mfg. Co.  
Monsanto Chemical Co.  
Munning & Munning.  
Musick Plating Co.  
Oakite Products, Inc.  
Pemeo Corp. (Howard Williams).  
Pesco Plating Equipment Corp.  
Puritan Mfg. Co.  
Rapid Electric Co.  
Re, Andrew V.  
Reinken, Lou.  
Roto-Finish Co.  
Schulze, Arthur P.  
Standard Rate & Data Service (Victor Vonn).  
Sulphur Products Co. (W. S. McKeon).  
Tajima, Sakae.  
Thee, Gus.  
Tin Research Institute.  
Tutrone Printing Co.  
Tyson & Co., O. S., Inc.  
Universal Engraving Co.  
Waters, Norman D. & Associates.  
Wein, Samuel.  
Whitfield Chemicals (Chet Smith).  
Wingate, Joseph.

## Oakite Holds Annual Technical-Sales Meetings

Field service representatives from the Canadian, Detroit, New England,



New York, and Philadelphia sales divisions of *Oakite Products, Inc.*, manufacturers of specialized industrial cleaning materials, attended a series of technical-sales meetings at the Hotel Commodore, New York City, December 15-17. Highlighting these meetings were reports delivered by the company's research chemists and service engineers on latest trends in cleaning and related procedures designed to assist industry in combating rising production costs. Also reported upon were new materials to be made available.

able by the company during the coming year.

Similar regional conferences held at the Sheraton Hotel, St. Louis, December 8-10, and the Biltmore Hotel, Los Angeles, November 28-30, were attended by representatives from Oakite's Chicago, Cleveland, Midwestern, Milwaukee, St. Louis and Southern divisions, and its North Pacific, South Pacific and South western sales territories respectively.

#### Emmerich New Sales Manager for J. J. Siefen

Mr. A. J. Emmerich has been ap-



A. J. Emmerich

pointed sales manager of the *J. J. Siefen Company, Detroit, Mich.*, in line with their expansion program of the manufacturing of liquid buffing and polishing compounds.

Mr. Emmerich was formerly salesman in the Detroit area, and brings into the national picture his extensive experience.

#### Cowles Conducts Metal Cleaner Clinic

"New Products for Better Cleaning" was the theme of a recent sales clinic conducted by *Cowles Chemical Company* at its general offices in Cleveland, Ohio. All Cowles technical men in the Metal Cleaner Dept. participated in the three day session at which several new products were introduced to the sales staff for the first time. These developments are the result of many months of intensive research at the company's Research and Development Laboratory at Syracuse, New York. It is expected that the first of the new products will be officially announced to the trade within the next few weeks. Technical discussions were led by Dr. C. W. MacMullen, Technical Director, and Clarence G. Ozar, of the Metal Cleaner Service Laboratory.

# EVERYTHING YOU NEED IN A RACK COATING!

#### Unichrome Coating 218X—a plastisol—provides this top combination of properties needed for real service:

You get the ideal rack protection in Coating 218X. For (1) It resists abrasion and impact—so Coating 218X is not prone to mechanical damage! (2) It stands up in acids, and hot alkaline solutions, and even degreasers—so you can work it through any plating cycle! (3) This coating is easy to apply and has unusual adhesion! (4) To cap it all, a United Chromium Service Engineer gives you any technical help you require to do a top quality coating job.

No wonder Unichrome Coating 218X rates "EXCELLENT" in the report of a leading automotive producer. Another company is covering every chromium plating rack in the plant with it. A third user affirms never having a coating able to take rough handling and hundreds of vapor degreasing cycles like this plastisol! So it goes in hundreds of plants—longer service, lower costs.

You too can be sure of satisfactory applications. Get acquainted with "218X"—you'll profit by it. Write for more data.

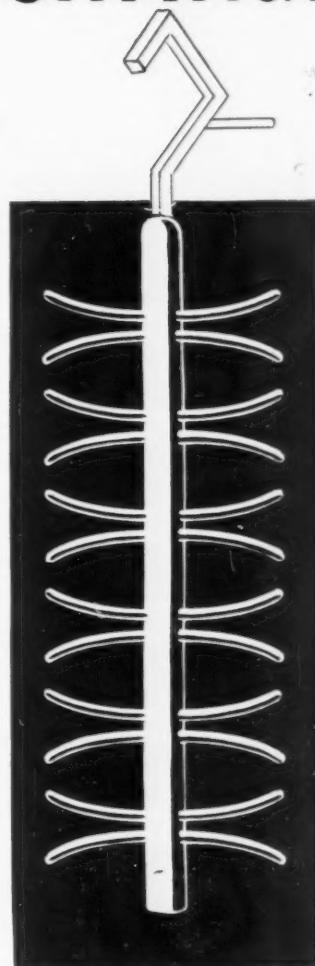
Nearby applicators can do the coating job for you if you have no baking oven. Ask for names.



Trade Mark

RACK COATINGS—Products of  
UNITED CHROMIUM, INCORPORATED

51 East 42nd St., New York 17, N. Y.  
Ferndale Sta. Detroit 20, Mich. • Waterbury 90, Conn.  
Chicago 4, Ill. • Los Angeles 13, Cal.  
In Canada: United Chromium Limited, Toronto, Ont.



#### Brown Starts New Training School Schedule

Industrial instrumentation training school schedules to be conducted for the first six months of 1950 by Brown Instruments Div. of Minneapolis-Honeywell Regulator Co. will include four short courses of five weeks each and one long course of 13 weeks.

The regular comprehensive 13-weeks course will start on February 27 and will end on May 26. In this, and in the shorter courses, lecture and bench instruction will take up new and improved types of industrial measuring, indicating and controlling instruments. These will include millivoltmeter-type pyrometers, continuous balance (Electronik) potentiometers,

electrically-operated automatic control, flow meters, thermometers, pressure gauges, hygrometers, air-operated automatic control, Moist-o-Graphs, tachometers, resistance thermometer—CO<sub>2</sub> and analygraph.

The classes, to be held at the Brown School of Instrumentation in Philadelphia, are designed to benefit industrial plants by instructing their engineers in modern industrial instrumentation application and maintenance.

#### E. S. Kopecki Joins Pennsalt

Ernest S. Kopecki has recently joined the Pennsylvania Salt Mfg. Co. as a sales service representative in the Special Chemicals Department, Joseph



## THE **BIAS** BUFF

—as manufacturers, we make no sweeping claims about the savings effected by the use of our BIAS Buffs. Our customers tell us that a lot of time and money is saved by using our buffs. No one says just how much is saved, for conditions are not alike in all plants and shops.

But we do say—

**BIAS Buffs retain  
100 per cent of  
their Cutting Efficiency  
— straight down to the  
Core**

Now, there is a reason for that—better material, expert and long experienced workmanship combine to produce this desirable result for the buff user—and he keeps using BIAS Buffs because of their longer life and service.

*Our illustrated catalog gives full details about BIAS Buffs. Send for it on your letterhead.*

### The BIAS BUFF and WHEEL CO.

Division of REIGEL TEXTILE Corp.

3466-66 Hudson Boulevard

JERSEY CITY 7

New Jersey

J. Duffy, Jr., manager of the Department, announced.

Coming to Pennsalt with extension experience in the field of metallurgy, Mr. Kopecki earned his degree of Bachelor Science in Chemical Engineering at Marquette University and his Master's Degree in Metallurgy at Carnegie Institute of Technology.

During the war he served with the Navy's Bureau of Ordnance in Washington and was separated from service as a Lieutenant Commander. Since then and until joining Pennsalt he has been metallurgical editor of "Iron Age."

### Du Bois Company Acquires Giant Products Co.

The DuBois Co., Cincinnati, manu-

facturer of specialized cleaning and processing compounds, has purchased the Giant Products Company of Los Angeles.

In announcing the acquisition, T. V. DuBois, president, pointed out that it adds to the DuBois organization the facilities of a branch manufacturing plant, laboratories, and offices on the west coast.

The 15-year-old Giant Co., whose products generally parallel those of The DuBois Co., has operated chiefly west of the Rockies, with the bulk of its sales force in Southern California. Its modern plant occupies a full city block adjacent to downtown Los Angeles. A feature of the plant is its well-planned loading and shipping facilities, which include a 6-car rail

siding and permit truck loading on all three other sides.

### Shannon New Promotion Manager for Diversey

Mr. R. L. Shannon, formerly a district manager in the Metal Industries Department of the Diversey Corp.



R. L. Shannon

Chicago, has been named promotional manager. Announcement was made by W. E. Noyes, Diversey's general sales manager. Shannon succeeds B. B. Button, who has been promoted to the position of special assistant to Mr. Noyes.

Shannon joined the Metal Industries Dept. six years ago, and after going through the sales training class was assigned as a field service representative in the North Chicago sales territory. Subsequently, he was advanced to field, then district manager, taking over supervision and management of the entire Chicago sales territory for the Metal Industries Dept.

### Martin Dennis Co. Becomes Div. of Diamond Alkali

The Martin Dennis Co., a wholly owned subsidiary of Diamond Alkali Co. with plants at Newark and Kearny, N. J., will become an operating division of Diamond. This change in status, effective January 1, 1950, was announced by Raymond F. Evans, president of the parent organization.

A producer of chromium chemicals, The Martin Dennis Co. was organized in 1893 as a New Jersey corporation. It was purchased by Diamond in March, 1948. Its products are used principally in the manufacture of pig-

ments, leather tanning and chrome-plating.

#### Plastics Metallizing Firm Formed

American Electro Products, Inc., of 1358 Thomaston Ave., Waterbury, Conn., announces the completion of facilities for the metallizing of plastics using their newly developed procedure. All classes of plastic materials may be handled in any size, and production rates are high with costs correspondingly low. The final surface may be copper, nickel, silver, gold or any other metal specified, and is produced with a high lustre or satin finish.

The process is particularly well adapted for metallizing large plastic items where controlled thicknesses of metal may be deposited over the entire surface or on selected areas only.

#### Harris Joins Magnus Chemical Co.

The Magnus Chemical Co., Inc., Garwood, N. J., manufacturers of industrial cleaning compounds, announces that Sidney G. Harris has joined the company in the capacity of Sales Engineer.

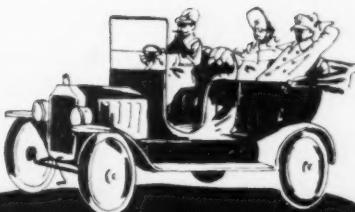
Mr. Harris, who received his engineering and marketing education at Polytechnic Institute of Brooklyn and Columbia University, is well known throughout the automotive engineering field. He is a member of the Society of Automotive Engineers, American Society of Lubrication Engineers and Society of American Military Engineers.

A Lieutenant-Colonel in the United States Air Force Reserve, Mr. Harris received the Army Commendation Ribbon for services during World



Sidney G. Harris

*Since the Beginning  
of Mass Production*



# BLAKESLEE

**Has Pioneered and Developed  
METAL PARTS WASHERS**



The first metal parts washer was built by Blakeslee . . . an outstanding contribution to mass production methods. Today,

Blakeslee metal parts washers are familiar throughout the automotive, aviation and countless other industries.

Whether your finishing operation is enameling, lacquering, machine plating or inspecting, you can depend on a Blakeslee washer. Blakeslee spray, power spray, spiral tumbling or the exclusive Niagara power paddle washing principles, provides a right cleaning method for every type of operation.

Pickling machines, Quenchers and Solvent Vapor Degreasers are also manufactured by Blakeslee. Here you'll find everything you need to prepare your product for finishing.

 Engineered,  
for You!

Our experienced staff of practical engineers is ready to help you with your cleaning problems.

## G. S. BLAKESLEE & CO.

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BLACOSOLV  
DEGREASERS AND SOLVENT

NIAGARA  
METAL PARTS WASHERS

War II. He recently graduated from the Air Command and Staff School.

Before joining Magnus, Mr. Harris was associated with nationally-known chemical firms as Manager of Sales-Engineering.

#### DeMambro New Lincoln Park Industries President

At their December meeting in Detroit, the directors of Lincoln Park Industries, Inc., elected Gene DeMambro president of the corporation, which includes in addition to the Lincoln Park, Michigan plant, the Curtis Machine and Standard Portable Cord divisions at Jamestown, N. Y.

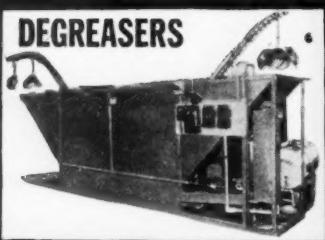
Mr. DeMambro had been vice president of the corporation and general manager of the Curtis Machine Division, and his advancement to the top

executive position was both deserved and self earned. His industrial career began when he started working for the Ford Motor Co., going thru the Ford Trade School and becoming a foreman. He also studied law at night school and when he left Ford in 1933 to begin the practice of law he was a production engineer. He continued his law practice until 1942 when he entered the Navy, serving as a commander at Washington and in the Pacific (Okinawa) until his discharge in 1946.

Leaving the Navy, he purchased the Curtis Machine Corporation of Jamestown, which had been founded in 1913 to make abrasive belt sanding, grinding and polishing machines for the woodworking and metal fields. Under his direction, Curtis Machine made

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A complete line of OPTIMUS Equipment is available in standard and special sizes to meet every metal parts cleaning problem and allied processing applications.

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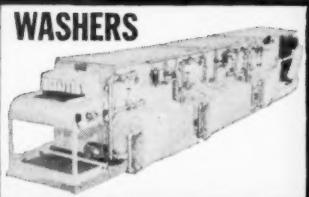
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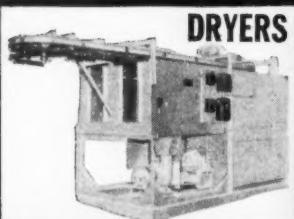
**A Trichlorethylene Degreaser Solvent**

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ADDITIONAL INFORMATION.

## WASHERS



## DRYERS



# OPTIMUS

# EQUIPMENT

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great strides. The entire line was redesigned for greater operational efficiency, new machines introduced, plant facilities modernized and expanded and employment stepped up more than 500%. In 1946 Curtis Machine was merged with Lincoln Park Industries, makers of high precision carbide dies and gauges, and in February 1949 the organization was further expanded by the purchase of the Standard Portable Cord Company of Lincoln Park, makers of portable cord trouble lights, motor cords and harnesses, extension cords and components. To provide greater plant facilities, more efficient production and management coordination, the Standard Portable Cord operation was moved to 1300 E. Second St., Jamestown, as were the executive, sales and general offices of the

corporation. These moves and the selection of Mr. DeMambro for the over-

all executive direction are part of Lincoln Park Industries long range program of product, plant and market expansion.

### Benner New Du Pont Manager of Electroplating

Harry L. Benner, who on October 17, 1949 completed twenty years of service with the du Pont Co., has been



Harry L. Benner

transferred from the Detroit district, where he was electroplating technical representative, to the main office at Wilmington, Dela., where, as Manager of Electroplating Service, Electrochemicals Department, he will head up nation-wide technical activities of du Pont in electroplating.

Until 1938 Mr. Benner was located at Niagara Falls engaged in research, principally in the electroplating field. The following three years he was attached to the Cleveland Office as electroplating service man covering Ohio and Indiana. He then returned to Niagara Falls as supervisor of Electroplating Research and Development. In 1944 he moved to Detroit, handling electroplating service activities in that district.

### Laplace Building New Quarters

The L. J. and M. Laplace Co., of 33 Zabriskie St., Hackensack, N. J., manufacturers of inks, industrial coatings, and chemicals and equipment for the electroplating industry announce their new building program which is now under way in East Patterson, N. J. The plant will cost over \$100,000 when completed, and will permit rapid and efficient attention to the needs of their many customers, according to the management.



Gene Demambro

**R. T. Pring New Head of  
American Wheelabrator  
Dust and Fume Div.**

Robert T. Pring has been appointed Technical Director of the Dust and Fumes Division of American Wheelabrator & Equipment Corp., Mishawaka, Ind., effective January 1.



Robert T. Pring

After obtaining a Bachelor of Science degree in Chemical Engineering from Tufts College in 1933, Mr. Pring completed graduate work in industrial hygiene at the Harvard School of Public Health in 1935. Following two years as an engineer with the Employers Group, Boston, he entered the employ of the Utah Copper Company in 1936 as Industrial Hygienist. In 1940 he became Chief Chemist of Utah Copper, and became Director of the Industrial Hygiene Department of Kennecott Copper in 1947. He has resigned this latter position in order to assume his new duties as Technical Director of the Dust and Fume Division of American Wheelabrator.

While with Kennecott Copper, Mr. Pring served as a consultant to other companies and lectured on industrial hygiene at the University of Utah Medical School.

**Drew Appoints Dr. Zinzalian  
as Sales Manager**

The E. F. Drew & Co., Inc., has announced the appointment of Dr. George Zinzalian as Sales Manager of the Technical Products Division.

Dr. Zinzalian has been connected with the Drew organization for over 16 years, serving in important capacities including supervision of produc-

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tion, product development and research at the Boonton, N. J. plant.



Dr. George Zinzalian

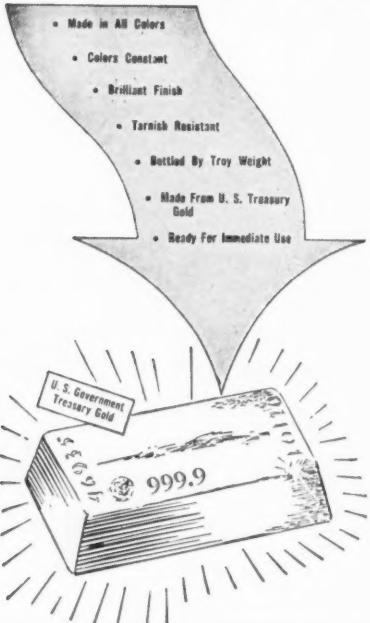
Dr. Zinzalian will direct the sales and service activities of the Technical Products Division and Textile and Leather Oils Departments, and he will be responsible for the sale of all products produced by these departments. Dr. Zinzalian will be located at the general offices of the Drew Company at 15 East 26th Street, New York 10, New York.

### News from California

Climaxing an eight months program of research, development and expansion, during which the firm's line of all-metal mountings and equipment for plating baby shoes was increased to a full line of such items, Hollywood

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### PRINCIPLES OF ELECTROPLATING AND ELECTROFORMING

By WILLIAM BLUM  
Chemist, U. S. Bureau of Standards  
and GEORGE HOGABOOM  
Consultant

This text gives a thorough treatment of such basic topics as—protection against tarnish, corrosion, wear; qualitative, quantitative analyses of solutions; pickling, dipping; electropolishing; electroforming; electrotyping; reproducing phonograph record matrices, manufacturing tubes, etc.

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# SOLUTIONS

Bronze Supply, effective January 1, moved its general offices and engineering department into larger quarters at 1766 North Vermont Ave., Hollywood, Calif.

Warehousing and shipping facilities are maintained at 4646 Melbourne Ave., and the foundry and factory at 1624 East First St., Los Angeles, where the company's line of silver, gold, copper, bright nickel and chromium tanks, rectifiers, etc., especially designed for the needs of baby shoe plating, are produced.

Charles Auerbach, general manager also announced the opening of a mid-western office at 6141 Wentworth Avenue, Chicago, Ill., with David Galland as branch manager.

Preco, Inc., has moved into a new office and factory building at 630 East Slauson Ave., Los Angeles, where double its former space is available for the manufacture of heaters, circulating fans and precooling units.

### Course in Electroplating

The School of Technology of The City College of New York will again conduct courses to provide commercial electroplaters with a sound understanding of the principles of their work. Classes will be held on Monday evenings from 7:00-8:50 p.m., starting February 20th. A college course in general chemistry or extensive commercial plating experience is a prerequisite. Applicants must register in person at the Main Bldg., Convent Ave. and 139th St., N. Y. C., on Feb. 6-7. Fee for the course is \$14.00. There is also a registration fee of \$2.00 and a Library fee of \$1.00 for each student.

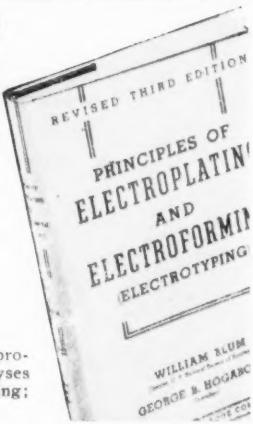
### Associations and Societies

#### AMERICAN ELECTROPLATERS' SOCIETY



#### Detroit Branch

The Detroit branch of the A. E. S. held its first meeting of 1950 on Friday, January 6, at the Statler Hotel. Guests of the Detroit branch were members of the Detroit section of the Electro-chemical Society, who turned out in goodly number.



Revised 1949 Edition  
455 pp., 6 x 9  
illus., \$6.00

George R. Petrie, of the U.S. Department of Commerce, Detroit office, gave a short talk describing the functions of the Department as it is related to scientific publications. Very many foreign and U.S. publications pertaining to plating are available to Detroiters at the Detroit office.

Herb Head reports that the Christmas party was a financial success and that no change in location of the 1950 party is contemplated.

A movie depicting the history of the animated cartoon was shown.

The principal speaker of the evening was Dr. Louis Weisberg, noted consulting chemical engineer, who spoke on "Polarization and Related Phenomena."

Liquid refreshments were served following the meeting.

#### New York Branch— Old Timers' Night

On Saturday evening, November 26th, at the Hotel Statler, New York City, the New York Branch of the American Electroplaters' Society held an "Old Timers' Nite" banquet and celebration in honor of a group of old time charter members of forty years ago when the Society's forerunner, The National Electroplaters Ass'n, was organized, and a number of twenty-five year members known as the "Quarter Century Club," some twenty-three members in all who were guests of the Branch with their wives or daughters on this occasion.

The celebration was presided over by Mr. Milton Nadel, the president of the Branch, who welcomed the guests and visitors and introduced the Master of Ceremonies, Mr. David X. Clarin, well known member of the Branch and Eastern Division Manager of Oakite Products, Inc. Mr. Clarin's exemplification of the job of toastmaster was all that could be desired as he introduced the honored guests of the evening and gave a resume of their careers and achievements in the A. E. S.

Among the honored group of Charter Members of forty years ago was the venerable and distinguished first president of the Society, Mr. George B. Hogaboom of New Britain, Conn.; author of many papers, Proctor Award winner, former member of the Society's Constitutional & Research Committees.

Mr. Horace Smith, Newark Branch; twice president of the A. E. S.; Chairman of three National Convention Committees and a lifelong activist in

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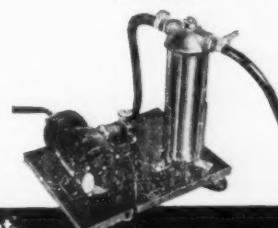
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the Society's Progress; member of many national committees, and Honorary Member of the Society.

*Mr. William Schneider*, Chairman, Board of Managers of New York Branch; prominently identified with the Society's activities; a speaker at many educational sessions and long time traveling representative of the R & H Division of Du Pont de Nemours Company, and Honorary Member of the New York Branch.

*Mr. Thomas Haddow*, Newark Branch; a foremost electroplater of the early days; active in furthering the progress of the Society from the beginning; traveling representative of the Maas & Waldstein Lacquer Co.

*Mr. Joseph Haas*, of the National Silver Company; a vice-president of the New York Branch; instructor in chemistry to early classes of the metropolitan group; former associate editor of the A. E. S. Monthly Review and the publication Brass World.

*Mr. Royal F. Clark*, Newark Branch, a nationally known electroplater and one of the early group of officers in the New York area; a leading activist of the formative years.

*Mr. Justus Strelle*, past president of New York Branch and member of Board of Trustees for many years; delegate to many conventions, and Honorary Member of New York Branch.

*Mr. William Fischer*, former secretary N. Y. Branch; a past president of Branch; Trustee and delegate to A. E. S. conventions; Honorary Member of New York Branch.

*Mr. William Voss*, holder of Branch offices; chairman of many committees; now metropolitan representative of Frederick Gumm Chemical Co.

*Mr. John E. Sterling*, long time secretary of New York Branch and Honorary Member; president of the Supreme Society of 1924-25 and member of many A. E. S. committees in early days of Society.

*Mr. Thomas Trumbour*, Honorary Member of New York Branch; perennial secretary of the International Fellowship Club and business manager of the publication, Metal Finishing; a leading publicist of the early New York group and the Society and attendant at all national conventions since 1913.

#### THE THIRTY-FIVE YEAR CLUB

*Mr. Harvey Miller*, one of the early technical group and a chemist plater; Winner of A. E. S. awards for paper submitted at conventions and Branch symposiums 1922-30; Branch advisor on educational programs.

*Mr. Joseph Minges*, past Branch officer and instructor of technical classes and Branch activist in many fields 1920-35.

*Mr. Philip Morningstar*, past president of New York Branch and chairman of several annual banquet committees; member of several Boards of Managers.

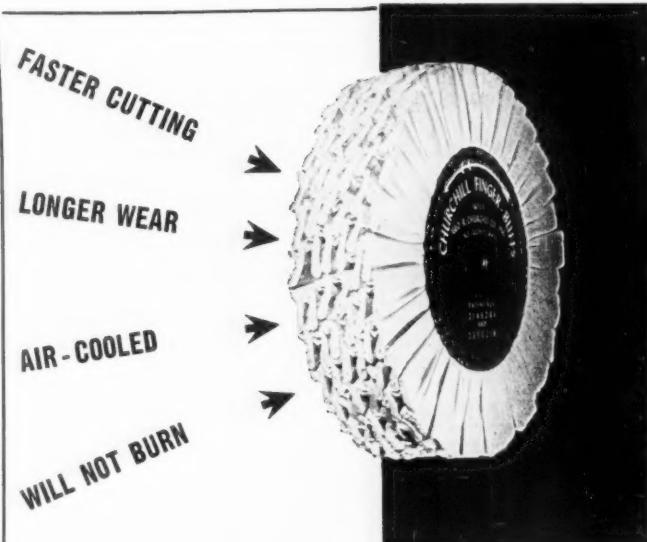
*Mr. Elias Schorr*, active committee worker and Branch Trustee for many years.

*Mr. Ben Cross*; active in many Branch Committees 1920-35.

#### THE TWENTY-FIVE YEAR CLUB

*Mr. Ralph Liguori*; seven term president of New York Branch 1936-43; co-chairman 1937 Jubilee Convention; delegate to many annual conventions.

*Mr. John Rolff*; past president of New York Branch; educational chair-



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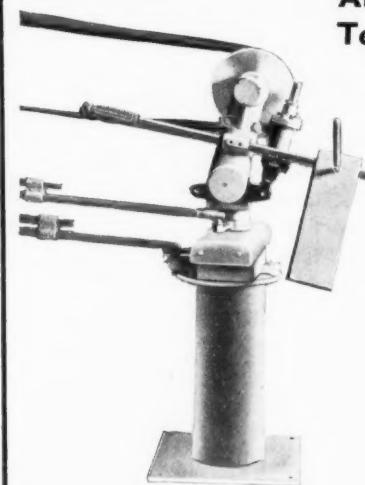
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man Silver Jubilee Convention; delegate to annual conventions.

*Mr. Franklyn J. MacStoker*; past president of New York Branch; Chairman of 1937 Silver Jubilee Convention at New York; Secretary-treasurer of Branch 1934 to present; member A. E. S. Research Committee 1940-44; Third Vice-President of A. E. S.

*Mr. Nat Fleet*; former librarian of Branch; active in Branch committee-work 1930-37; Now at Providence, R. I.

All of the old timers responded to their introduction by the Toastmaster, Mr. Clarin, with remarks and anecdotes relative to their association with the events of the early days at New York and elsewhere and aroused a sentimental interest among the 125 members of the New York, Newark and other branches who were present in addition to the honored guests and their wives at the gathering. They enjoyed an evening of fine music, dancing and entertainment, including a superb show of the magician's art generously donated and performed by *Mr. Paul Oldam*, of the Newark Branch, in honor of the old timers and the occasion.

### Los Angeles Branch

The Los Angeles Branch of the A.E.S. held its first meeting of the year at Scully's Cafe on the night of January 11, with 60 members in attendance.

*Allan Sulzinger*, of the Hughes Aircraft Co., presided, with *Walter Behlendorf*, of the Spence Plating Co., pinch-hitting for Secretary *Myron Orbaugh*, of the Bone Engineering Co., who was on an eastern trip.

*Peter Rogers*, committee chairman, reported that arrangements had been made to hold the 1950 annual educational session and dinner dance in Rodger Young Auditorium, Los Angeles, on March 18. In the main the program will follow the pattern of previous years, with educational sessions, featured by industry speakers, in the morning and afternoon, a luncheon interlude at noon, and the annual dinner and dance in the evening.

*Donald Vance*, chief chemist of Kelite Products, Inc., was initiated into membership.

*Herold Kroesche* reported on the electroplating television show given over Station KTLA, Los Angeles, on the night of January 8, declaring that

this first attempt on the West Coast to acquaint the public with some of the details of the plating industry went over in tip-top fashion. The 15 minute program, Kroesche reported, was presented in collaboration with the American Chemical Society which allotted to the A.E.S. Branch 15 minutes on its regular 30-minute weekly "Science Page" period. The program was called "The Electroplating Chemist in Action." Kroesche opened the program with a talk on polishing and buffing, followed by one by *Emmet Holman* on pre-cleaning. Both speakers refrained from making their comments too technical, and spoke in language understood by the average television viewer. The concluding part of the program was a plating demonstration conducted by *Mr. Kadison*, who worked with copper and nickel solution tanks set up in a plating shop arranged on the stage. The glass-lined fronts of the tanks made it possible for the audience to see the parts immersed in the solution. Turco Products Co. made a motion picture film of the television demonstration, a print of which was made available for projection at the January meeting of Los Angeles A.E.S. Branch.

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## Twin City Branch

The Twin City Branch of the A. E. S. met on Thursday, January 12, 1950 in the Lodge Room of the Covered Wagon Cafe in Minneapolis. There were 37 persons present.

Mr. Al Joyner, of the Silver Shop, Osseo, Minn., Branch First Vice-Pres., called the meeting to order following dinner, with the introduction of the following guests: Mr. Charles A. Blank, of the Kelite Products Co., Chicago; Messrs. Winse Sebatha and Cort G. Platt, of Northwest Airlines, Inc., St. Paul; Mr. Henry Makino, of Minneapolis Honeywell Regulator Co.; and Miss Majorie Lanmesser, of Schmitt Music Company, Minneapolis.

Following the introduction of guests, Mr. Al Joyner then introduced Mr. Howard K. Norman, of Magnus Chemical Co., who recently joined the Twin City Branch.

The meeting was then turned over to Branch Librarian Gunnar Deedon, of Turco Products, who advised that for the first time in the history of the Twin City Branch, the program for the January meeting had been arranged using all Twin City Branch members. The program was in the or-

der of having a Board of five members who attempted to answer any type of question submitted to them by the other members of the Branch. The members serving on the Board were Mr. Jerome Weller, of Brown and Bigelow, Inc., St. Paul; Mr. A. T. Leonard, of Superior Plating and Rustproofing Co., Minneapolis; Mr. F. H. McCoy, of Pioneer Plating and Rustproofing Co.; Mr. Arthur M. Carlson, of Arlington Machine Works, Inc., St. Paul; and Mr. Robert L. Buckley, of Industrial Chemical and Equipment Co., Minneapolis. Several subjects were discussed and questions answered by the Board relative to sulphate removal from chromium solutions, cleaning of zinc base die-castings, linings for chromium plating tanks, effects of a passive surface on metals and many other pertinent subjects.

## Dayton Branch

The Fifth Annual Educational Session and Dinner Dance of The Dayton Branch will be held on Saturday, February 25th, 1950, at the Biltmore Hotel, Dayton.

The Educational Session, starting at 2:00 p.m., will feature the following speakers and subjects:

Mr. Jack Winters, Research Chemist, R. O. Hull & Co., Cleveland, O.  
"Control of Plating Solutions by Hull Cell"

Mr. H. M. McAleer, President, Fopmax Mfg. Corp.

"Inside Story of Buffing Compound & Buffing Wheels"

Mr. R. W. Cook, President, Fat Film Corp., Cleveland, O.

"Fax Film Method of Comparing Surfaces"

The dinner dance will start at 6:15 P.M. in the Biltmore Hotel Ballroom, and will include dinner, music, floor show, favors, and dancing to Earl Holderman's Orchestra. The cost is \$5.00 per plate and dress is optional.

The Toulmin Award and The Dayton Award will be given at the Educational Session. Tickets may be obtained from Mr. Paul Geske, 41 South Bromfield, Dayton, O.

## SOCIETY OF AUTOMOTIVE ENGINEERS

### Zeder Heads Automotive Engineers for 1950

James C. Zeder, Chairman of the Engineering Board of Chrysler Corp.

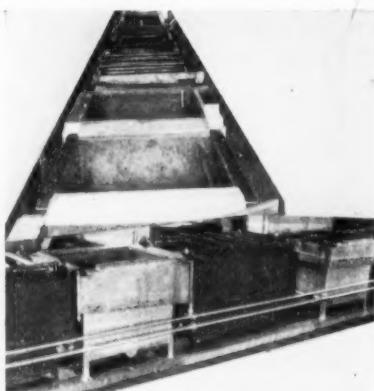
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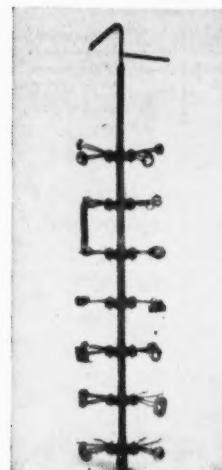
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Serving Mid-Western Industrial Area

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has been elected president of the Society of Automotive Engineers for 1950.

Zeder rose to his present position at Chrysler when its Engineering Board was first formed in 1946, having previously been chief engineer of all Chrysler laboratories since 1933.

During World War II, he conceived and stimulated organization of the SAE War Engineering Board, major war service agency of the Society of Automotive Engineers, and served as its chairman for six years. A graduate of the University of Michigan, Zeder holds an honorary master's degree from Lawrence Institute of Technology and an honorary doctor's degree from the University of Dayton.

Other officers elected by the Society for 1950 are: *Raymond D. Kelly*, United Air Lines, Vice-President, Air Transport Activity; *Harold D. Hoekstra*, Civil Aeronautics Administration, Vice-President, Aircraft Activity; *Wright A. Parkins*, Pratt & Whitney Aircraft, Vice-President, Aircraft Powerplant Activity; *Rex A. Terry*, Chrysler Corp., Vice-President, Body Activity; *Albert H. Fox*, Standard Oil Co.



James C. Zeder

of Indiana, Diesel Engine Activity; *Roy W. Roush*, Timken-Detroit Axle Co., Vice-President, Engineering Materials Activity; *Arthur O. Willey*, The Lubrizol Corp., Vice-President, Fuels & Lubricants Activity; *Edward N. Cole*, Cadillac Motor Car Division, GMC, Vice-President, Passenger Car Activity; *Robert F. Steenck*, Fafnir Bearing Co., Vice-President, Produc-

tion Activity; *Wayne H. Worthington*, John Deere Waterloo Tractor Works, Vice-President, Tractor & Farm Machinery Activity; *Matt E. Nuttila*, Cities Service Oil Co., Vice-President, Transportation & Maintenance Activity, and *William P. Michell*, Spicer Mfg., Division of Dana Corp., Vice-President, Truck & Bus Activity.

*William E. Conaway*, Studebaker Corp., *Philip J. Kent*, Chrysler Corp., and *Dale Roeder*, Ford Motor Co., are the three new councilors.

## ELECTROCHEMICAL SOCIETY



The annual meeting of The Electrochemical Society is to be held in Cleveland, Ohio, at the Hotel Statler, April 19, 20, 21, and 22, 1950. Symposia are now being planned on the following subjects: Theoretical Electrochemistry, Rare Metals, Instrumentation, Electrothermics, Luminescence, Industrial Electrolytes, and Electric Insulation.

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## Manufacturers' Literature

### Backstand Grinding and Polishing

*Behr-Manning Co., Dept. MF, Troy, N. Y.*

A fundamental discussion of the mechanics and economics of belt backstand polishing and grinding is contained in a new bulletin just issued by this firm. Diagrams and sketches illustrate the basic principles, and many photographs show actual production operations. Copies are available on request.

### Prepared Gold Plating Solutions

*Technic, Inc., Dept. MF, 39 Snow St., Providence, R. I.*

A bulletin just issued by this firm describes the many advantages obtained by using their Trushade Gold Plating Solutions for decorative gold plating of all types of jewelry and novelty items. A wide variety of colored golds are available, including hard gold, 14 kt., pink, green, white, Hamilton, and 24 kt. The firm also markets products for producing antique finishes on gold and silver, black finishes for

brass and copper, aluminum pre-plate treatments, hot and cold bright nickels, immersion tinning baths, rhodium solutions, and many other special processes for the metal finishing trade. In addition, the firm is equipped to render consulting and analytical service to the industry through their large staff of trained technicians and well equipped laboratory. Copies of this bulletin are available on request.

### Price List for Coated Abrasives

*Michigan Abrasive Co., Dept. MF, 2360 W. Jefferson Ave., Detroit, Mich.*

This firm has just issued their catalog price list on their line of Red-Coat brand coated abrasive items. Belts, rolls, discs, sheets are all included, in various types of abrasives, such as garnet, aluminum oxide, and silicon carbide. Ask for a copy of catalogue price list No. 8.

### 15" Continuous Wheelabrator Tumblast

*American Wheelabrator and Equipment Corp., Dept. MF, 555 S. Byrkit St., Mishawaka, Ind.*

Bulletin No. 654 on the new 15"

Continuous Wheelabrator Tumblast has just been published by this firm.

By utilizing the unique combination of tumbling and longitudinal travel of the work, this new airless blast cleaning machine offers thorough cleaning and uninterrupted efficiency, it is claimed. No time is lost for starting, stopping, loading, and unloading, as in the conventional type batch mill, since parts are fed into and discharged from the machine in a continuous flow.

Any plant with a large production of small parts, such as bearing retainers, coil springs, and pipe fittings, requiring blast cleaning, will find this unit exceptionally useful.

The bulletin is complete with pictures, drawings, specifications, and details of construction and operation. A copy of Bulletin No. 654 may be obtained by writing directly to the manufacturer.

### Industrial Washing Machines

*Alvey-Ferguson Co., Dept. MF, Cincinnati 9, O.*

A new bulletin just issued by the above firm describes and illustrates their line of industrial washing and cleaning machinery. The booklet takes the machines apart and shows how the

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firm engineers every part of their equipment for maximum efficiency; the spray system, pump, screening facilities, heating system, drying system, and conveyor mechanism are each described in detail, and a number of typical completed machines are shown for performing typical metal cleaning operations. The bulletin thus serves as a text on cleaning machine fundamentals. Copies are available on request.

### **Stainless and Monel Metal Wire Ropes**

*Macwhyte Co., Dept. MF, Kenosha, Wisc.*

Stainless steel and Monel metal wire ropes are becoming more popular where corrosion affects uncoated carbon steel and galvanized ropes, says this manufacturer, in a new folder (Number 49-30) released by them recently.

Typical uses for each rope are listed, and the 133 sizes and types available are described and illustrated.

A copy of this folder is offered to anyone interested in corrosion-resisting wire rope.

### **Industrial Rubber Gloves**

*B. F. Goodrich Co., Dept. MF, Akron, O.*

Industrial and acid gloves are pictured and described in a new catalog section issued by the above firm. Copies are available upon request. Various types are listed, and complete specifications given, and the uses for each kind outlined.

### **Levelimeter Instruments Catalog**

*Fischer & Porter Company, Dept. MF, 75 County Line Rd., Hatboro, Pa.*

A completely new 24-page illustrated catalog describing the company's line of Levelimeter instruments has just been published by the above firm. These instruments indicate, measure and control liquid level and inter-face level. Variations in liquid level in weirs and flumes are utilized for measurement and control of large flow rates.

Illustrated and described are magnetic tape - and - drum, electronically transmitting, ball-float, pneumatic and differential pressure units; V-notch weir and Parshall flume flowmeter instruments; and chemical service sight gauge glasses.

## **NEW BOOKS**

### **36th Annual Proceedings of the American Electroplaters' Society**

*Published by the American Electroplaters Society, P.O. Box 168, Jenkintown, Pa. Price \$5.00 to non-members. 272 pages.*

This is the bound volume published yearly by the Society and contains all the technical papers presented before the Annual Convention held in Milwaukee in June 1949, together with the discussions following the presentation of each paper. It also contains the report of the annual meeting and various other reports of Society activities. The following technical papers are included:

*The Customer Looks at Plated Products*—by T. H. Westby and R. E. Parkinson.

*Process Control in Electroplating*—by R. E. Harr.

*The Job Plating Business*—by R. M. Shock.

*Symposium on the Availability of Plating Chemicals and Materials*—by various authors.

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*PR Cyanide Copper Plating*—by G. W. Jernstedt.

*Electrodeposition of Nickel at High Current Densities*—by W. A. Wesley, W. W. Sellers, and E. J. Roehl.

*Factors That Influence Operating Characteristics of Chrome Plating Baths*—by J. B. Winters and R. O. Hull.

*Scratch Hardness and Abrasion Hardness of Electrodeposited Chromium*—by J. M. Hosdowitch.

*Acid Dips in Cleaning Cycles*—Symposium

Dips for Low-Carbon Steel—by I. Hepfer.

Dips for High-Carbon Steel—by R. M. Wick.

Dips for Copper Base Alloys—by B. H. McGar.

Dips for Zinc Base Metals—by D. M. Overcash.

*Plating on Aluminum*—by F. Keller and W. G. Zelley.

*Cleaning, Acid Treatment, and Chemical Brightening of Aluminum*—by W. R. Meyer and S. H. Brown.

*Amorphous Phosphate Coatings for Aluminum Alloys and Paint Adhesion*—by A. Douty and F. P. Sprance, Jr.

*Plating on Magnesium Alloys*—by H. K. DeLong.

*Distribution of Electrodeposited Metal on Some Simply Shaped Cathodes*—by J. Kronsbein.

*Problems of Porous Structure in Electrodeposits*—by N. Thon.

*Present Status of Plating Room Waste Disposal*—by F. C. Gurnham and B. F. Dodge.

### Tool Engineers Handbook

*Published by the McGraw-Hill Book Co., New York, N. Y. Price \$15.00.*

This book, which was compiled by the Handbook Committee of the American Society for Tool Engineers, is a 2,000 page manual covering all phases of planning, control, design, tooling, and manufacturing operations. It will rank as an equal volume to such well known handbooks as the Metals Handbook and the Handbook of Chemistry and Physics. The various sections are written by men recognized throughout their respective fields as experts, and in fact this handbook could well be described as a bible on modern manufacturing practice and procedures, as its 115 sections cover every phase of present-day production methods. It would have been an equally wise act if an attempt were also not made to cover the non-ferrous alloys in the small amount of space allotted. As it is, the subjects of heat treatment and precipitation hardening are the only topics discussed for this group of alloys, but there is a fairly good coverage of these topics included. The book is one which will not appeal to any but the trained metallurgist who is looking for specific

would be hard to understand why anyone connected with the mechanical end of manufacturing would not want a personal copy of this book.

### Alloy Steels, Cast Iron and Non-Ferrous Metals

*By F. Johnson. Published by the Chemical Publishing Co., Brooklyn 2 N. Y. Price \$5.00.*

The title of this book would make one suspect that the era of plain old-fashioned carbon steels was a thing of the past. However, as the greater part of any discussion of carbon steels would of necessity have to be merely a repetition of previous works, it is perhaps well that the author chose to omit a discussion of these steels. It would have been an equally wise act if an attempt were also not made to cover the non-ferrous alloys in the small amount of space allotted. As it is, the subjects of heat treatment and precipitation hardening are the only topics discussed for this group of alloys, but there is a fairly good coverage of these topics included. The book is one which will not appeal to any but the trained metallurgist who is looking for specific

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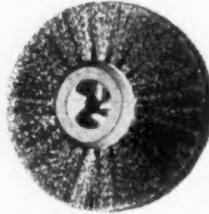
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information. For this type of individual, however, the volume will be found to contain a large amount of data of practical importance. It is not the type of book one would curl up in front of the fireplace with, but should find use in the library of the practicing metallurgist.

W. A. R.

### Technology of Light Metals

By A. von Zeerleder. Published by the Elsevier Pub. Co., Inc., 215 Fourth Ave., N. Y. C. Price \$6.00. 366 pages.

This is a translated edition of the original German text, and covers all phases of light metal technology from the design stage through the final methods for fabrication, including soldering, welding, and surface finishing. It is the final chapter on Surface Treatment which will appeal mostly to the metal finisher; it covers both mechanical surface treatments and chemical treatments. Electroplated coatings are given only two pages, and paint coatings only one page.

F. T.

## TECHNICAL LITERATURE

### A.S.T.M. Standards on Soaps and Other Detergents

American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. Price \$1.75 each. 132 pages.

The November 1949 edition of this publication, prepared by A.S.T.M.

Committee D-12 on Soaps and Other Detergents, brings together in convenient form for use in industry all of the A.S.T.M. standards pertaining to soaps and other detergents. There are 32 specifications and tests giving quality requirements.

Specifications for soap cover the following: bar and various kinds of chip soaps; powdered and salt water soaps; olive oil and palm oil solid soaps; milled, floating and liquid toilet soaps.

Specifications for detergents cover: borax; soda ash; caustic and modified soda; sodium bicarbonate, metasilicate and sesquisilicate; trisodium phosphate; tetrasodium pyrophosphate (anhydrous).

Methods of tests and analytical procedures include: sampling and chemical analysis of soaps and soap products and of soaps containing synthetic and alkaline detergents; chemical analysis of sulfonated and sulfated oils and of industrial metal cleaning compositions; test methods for particle size of soaps and other detergents; and total immersion corrosion test of water-soluble aluminum cleaners.

Definitions of terms relating to soaps and other detergents are also included.

### Disposal of Plating Room Wastes

By B. F. Dodge and D. C. Reams. Report No. 14 of AES Research Program. Available from American Electroplaters Society, P. O. Box 168, Jenkintown, Pa. Price \$1.00 per copy.

While the first report on this subject by the above authors covered an extensive bibliography of the more important references to the subject, this second part of the report consists of a critical review of the previously proposed methods for treating plating wastes containing cyanides. The methods discussed include dilution, removal as hydrogen cyanide (gas), al-

kaline treatment, oxidation with chlorine, permanganates, peroxides, ozone, alkaline picrates and electrolytic oxidation, conversion to thiocyanates, drying at elevated temperatures, and ion exchange. Additional references not included in the first report are also included.

### Review and Directory of University Research Projects

Engineering College Research Council, College of Engineering, State U. of Iowa, Iowa City, Ia. Price \$1.75 postpaid.

Over 4000 current college and university research projects in engineering subjects, representing expenditures of over \$35,000,000, are listed by title in the 1949 *Review of Current Research*, published this week by the Engineering College Research Council of the American Society for Engineering Education.

Entries in the book from 82 educational institutions which hold membership in the Research Council describe the administrative policies for conducting engineering research and list the responsible personnel, research expenditures, short courses and conferences of special interest, and the titles of all engineering research studies currently active at each institution.

Use of the volume is facilitated by a breakdown of research projects according to the engineering departments involved, and by a complete index to research project subjects.

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## Letters to the Editor

### Silver Brightener

METAL FINISHING  
11 W. 42nd St.  
New York 18, N. Y.

*Dear Editor:*

In regard to the Brightener for Silver Plating mentioned in your Question Column of the June and Sept. edition, I believe this is a product introduced here in Sweden around 1940 by the Schering Co., of Germany.

I understand it is a selenium or tellurium compound plus a colloidal organic compound, which depresses the surface tension of the silver plating solution considerably. It produces a very bright, at times very hard and brittle silver deposit at a rather low current density.

In 1941, a few silverware manufacturers in Stockholm used the product, but in the later war years the quality grew worse and worse. At the present time, a firm in Stockholm is again marketing the product, claiming that it is the same as the original Weiner

product, originally manufactured by the Schering Co. in Berlin.

Hoping this letter will be of some assistance to you, I am

*Very truly yours,*

Bror Eliasson,

Eliassons Kemiska AB  
Eskilstuna, Sweden.

### Chrome Plating Over Silver Plating

*Mr. W. A. Raymond, Editor  
Metal Finishing  
New York City, N. Y.*

*Dear Mr. Raymond:*

In reference to the shop problem published in the November 1949 issue regarding chrome plating over silver plating, I would like to add the following comments.

Chrome plating over silver can be done; the chrome plating will not be bright but will be a dull matte, regardless of any pre-plating treatment you give it (except bright nickel), because immediately upon insertion of a silver surface into a chrome plating bath a brownish-red deposit of silver chromate is formed, together with a dulling of the silver surface. Chrome plating will take place but the plate will be a dull matte.

This reaction between silver and chromium plating baths is well known in electroforming where it is used as a separating film to separate two surfaces, such as a plate from a master.

*Very truly yours,*

JOSEPH HAAS

### High Pressure Sandblasting

*EDITOR  
Metal Finishing  
11 West 42nd Street  
New York 18, New York*

*Dear Sir:*

I have read with interest the article entitled "High Pressure Sandblasting" by Joseph Albin in your August issue.

The photographs on pages 56 and 57 indicate that the problem of protecting the bottom of the sandblasting cabinet from the abrasive material certainly exists. You will note that they are using a small metal plate and a hole has been blasted thru exposing the bottom of the cabinet.

In 1943 we were faced with the same problem. We even tried boiler plate  $1\frac{1}{2}$ " thick, but soon a hole was blasted thru the plate and then it had to be replaced or ruin the steel bottom

of the cabinet. We were using No. 70 angular steel grit which was much tougher than sand.

We procured a sheet of No. B-100 Resistoflex PVA Sheet,  $20'' \times 20'' \times \frac{1}{16}$ " from the Resistoflex Corp., Belleville 9, N. J., and our troubles were over. This is an amber colored sheet and will resist sandblast wear a hundred times longer than boiler plate. We later covered the four walls of our cabinets with this material using a special cement furnished by the same company.

Figure 1 on page 56 shows another possibility. The top of the wooden box could be covered with this material and holes bored thru it to allow the valve stems to pass. This can also be done on any type of holding fixture with fine results.

If you wish, you may pass this information on to your readers for I am certain it will save many dollars for anyone who cares to try it out.

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